OFC/NFOEC 2011 Archive

Technical Conference: March 6-10, 2011

Exposition: March 8-10, 2011

Los Angeles Convention Center, Los Angeles, CA, USA

At OFC/NFOEC 2011, the optical communications industry was buzzing with the sounds of a larger exhibit hall, expanded programming, product innovations, cutting-edge research presentations, and increased attendance March 6 - 10 in Los Angeles.

The exhibit hall grew by 20 percent over last year, featuring new programming for service providers and data center operators, and more exhibitors filling a larger space, alongside its core show floor programs and activities. The more than 500 companies in the exhibition hall showcased innovations in areas such as 100G, tunable XFPs, metro networking, Photonic Integrated Circuits, and more. On hand to demonstrate where the industry is headed were network and test equipment vendors, sub-system and component manufacturers, as well as software, fiber cable and specialty fiber manufacturers. Service providers and enterprises were there to get the latest information on building or upgrading networks or datacenters.

OFC/NFOEC also featured expanded program offerings in the areas of high-speed data communications, optical internetworking, wireless backhaul and supercomputing for its 2011 conference and exhibition. This new content and more was featured in standing-room only programs such as the Optical Business Forum, Ethernet Alliance Program, Optical Internetworking Forum Program, Green Touch Panel Session, a special symposium on Meeting the Computercom Challenge and more. Flagship programs Market Watch and the Service Provider Summit also featured topics on data centers, wireless, 100G, and optical networking.

Hundreds of educational workshops, short courses, tutorial sessions and invited talks at OFC/NFOEC covered hot topics such as datacom, FTTx/in-home, wireless backhaul, next generation data transfer technology, 100G, coherent, and photonic integration. Technical presentations were given on timely topics such as cloud computing, data center processing, multiplexing and record data rates of more than 1 Terabit per second.

Leading off the keynote presentations at the Plenary Session was Bruno Orth, Senior Vice President, Strategy and Architecture at Deutsche Telekom in Germany. Orth spoke on how innovation, convergence and scalability in volume and cost of networks will enable DT to prepare its business for the future. AT&T's Senior Vice President of Architecture & Planning Kristin Rinne discussed the company's efforts to deploy the next generation, high-efficiency mobility network known as LTE. Alan Gara of IBM rounded out the talks with a look at high-performance computing and how optics will be a key component in the race to develop the world's fastest supercomputer for applications as diverse as smart grid operability and climate modeling to whole organ simulation and pandemic prevention.

As the only conference and exhibition in 2011 that offers programming for all sectors of the telecom field, OFC/NFOEC proved to be the premier destination to stay up-to-date on the industry. With an increase in attendance to 11,100, OFC/NFOEC remains the largest show of its kind in the world. Join us next year as the telecom, networking, datacom and computing worlds converge for OFC/NFOEC 2012, March 4 – 8 in Los Angeles.

Agenda and Abstracts

OFC and NFOEC Abstracts

Monday, March 7, 2011

Tuesday, March 8, 2011

Wednesday, March 9, 2011

Thursday, March 10, 2011

Agenda of Sessions and Key to Authors and Presiders

Agenda of Sessions

Key to Authors and Presiders

Postdeadline Paper Agenda and Abstracts

Agenda and Abstracts

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S. J. Ben Yoo, *Univ. of California at Davis, USA*

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Chuck Joyner, *Infinera, USA*
Akihiko Kasukawa, *Yokohama R&D Labs Furukawa Electric Co., Japan*
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Clint Schow, *IBM T. J. Watson Res. Ctr., USA*
Michael Tan, *Hewlett Packard Labs, USA*
Ioannis Tomkos, *Athens Information Technology Ctr., Greece*

Packet Switching Symposium
Mounir Hamdi, *Hong Kong Univ. of Science and Technology, Hong Kong*
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Dominic Schupke, *Nokia Siemens Networks, Germany*

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Atul Srivastava, *OneTerabit, USA*
Andrew Yablon, *Interfiber Analysis, USA*

Invited Speakers

Category 1. Optical Network Applications and Services

NThC1 Comcast Optical Network: a Truly Converged Infrastructure, Shamim Akhtar; *Comcast, USA*

NThD2 Drivers and Applications of Optical Technologies for Internet Data Center Networks, Vijay Vusirikala; *Google, USA*

NThD5 eScience Applications on the SURFnet RE Network, Cees de Laat; *Univ. of Amsterdam, Netherlands*

NThD1 Microsoft Data Center Connectivity and Requirement on Optical Networks, Al Greenberg; *Microsoft, USA*

NMC1 OTN to Enable Flexible Networks, Virginia Hutcheon; *AT&T, USA*

NMC2 The Telstra Network and Transport Technology Evolution, Frank Ruhl; *Telstra, Australia*

Category 2. Network Technologies and Applications

NWA1 100G—Key Technology Enablers of 100 Gb/s in Carrier Networks, Kim Roberts; *Ciena, Canada*

NWA6 100G—Photonic integration Challenges, Edmond Murphy; *JDSU, USA*

NTuA2 **Benefits of Closer and Methods for Automatic Cooperation between Packet and Transport Networks**, David McDysan; *Verizon, USA*

NWC5 **Digital Cinema Over Optical Network: Status of Super HD Development**, Tatsuya Fujii; *NTT Network Innovation Labs, Japan*

NThB4 **Fiber Nonlinearity Management—From Carrier Perspective**, Xiang Zhou; *AT&T Labs Res., USA*

NThB1 **OOO Switching – The Role and Technological Advances**, Ken-ichi Sato; *Nagoya Univ., Japan*

NWC2 **Progress in Soft-Decision FEC**, Takashi Mizuochi; *Mitsubishi Electric Corp., Japan*

Category 3. FTTx Technologies, Deployment, and Applications

NThF1 **DOCSIS provisioning of EPON/10GEPON; DPOETM for Business Services Scalability**, Shamim Akhtar; *Comcast, USA*

NWD4 **FTTP Opportunities in Emerging Markets**, Benoit Felten; *Diffraction Analysis*

NWD2 **Investment Optimization Planning for the Access Network**, Joseph Finn; *Verizon, USA*

NMD4 **New Enabling Technologies for Passive Optical Networks with Sustainable Growth**, Naoto Yoshimoto; *NTT Basic Res. Labs, Japan*

NTuD1 **Present State of Standards for Ethernet PON Systems**, Glen Kramer; *Broadcom/Teknovus, USA*

NWD3 **Regulation Environments around the World: Impacts on Deployments**, Fabrice Bourgart; *France Telecom, France*

NThF2 **RFoG – Foggy, or Real?**, Jim Farmer; *Enablence, USA*

NWD1 **The Business Case for PON**, Lowell Lamb; *Broadcom/Teknovus, USA*

NThF5 **The Evolution of Hybrid Fiber-Coaxial Cable Networks to an All-Fiber Network**, Dean Stoneback; *Motorola, USA*

Category 5. Fibers and Optical Propagation Effects

OWA6 A New Class of Optical Fiber to Support Large Capacity Transmission, Yoshinori Yamamoto; *Sumitomo Electric Industries, Ltd., Japan*

OMO6 Cooperative Light Scattering Effects in Optical Fibers, Lasers, and Amplifiers, Andrei Fotiadi; *Univ. of Mons, Belgium*

OWS5 High-Speed Short Range Transmission Over POF, Eduward Tangdiongga; *Eindhoven Univ. of Technology, Netherlands*

OTuJ1 Impact of Fiber Parameters on Nonlinear Fiber Capacity, Rene-Jean Essiambre; *Alcatel-Lucent, USA*

OWJ1 Multi-Core Fibers for Large Capacity SDM, Kazunori Mukasa; *Furukawa Electric, Japan*

OThS1 Optical Rogue Waves: Physics and Impact, Goery Genty; *Tampere Univ. of Technology, Finland*

OMO1 Quantum Effects in Optical Fibers, Gerd Leuchs; *nst. of Optics, Information and Photonics, Univ. of Erlangen-Nürnberg, Germany*

OWJ6 Recent Advances in MMF Technology for Data Networks, Denis Molin; *Draka Communications, France*

OMF1 Recent Progress in Optical Fiber Refractive Index Profiling, Andrew Yablon; *Interfiber Analysis, USA*

OWA5 Ultimate Limits of Effective Area and Attenuation for High Data Rate Fibers, Scott Bickham; *Corning Inc., USA*

Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors

OMH1 Advanced Fiber Optic Parametric Synthesis and Characterization, Evgeny Myslivets; *Univ. of California at San Diego, USA*

OTuC4 All-Silica Photonic Bandgap Fiber Oscillators and Amplifiers, Sebastien Février; *Xlim - Univ. of Limoges, France*

OTuC1 **Developments and Applications of Microstructured Fiber Bragg Gratings**, Andrea Cusano; *Univ. of Sannio, Italy*

OTuL1 **Distribution Optical Sensor System on the 610-m Guangzhou New TV Tower**, Hwa-yaw Tam; *Hong Kong Polytechnic Univ., China*

OMH2 **Evolution of Commercial EDFAs**, Maxim Bolshtyansky; *JDSU, USA*

OWC1 **Optical Processing for Performance Monitoring**, Mark D. Pelusi; *CUDOS, Univ. of Sydney, Australia*

OTuL6 **Photonic MircoCells Based on Hollow-Core PCF**, Fetah Benabid; *Univ. of Bath, UK*

OMQ1 **Random Distributed Feedback Fiber Laser**, Sergei Turitsyn; *Aston Univ., UK*

OMQ4 **Recent Progress on 2-Micron Fiber Lasers**, Shibin Jiang; *AdValue Photonics Inc., USA*

Category 7. Optical Devices for Switching, Filtering, and Signal Compensation

OThD1 **8-channel InP Monolithic Tunable Optical Router for Packet Forwarding**, Steven Nicholes; *Univ. of California at Santa Barbara, USA*

OTuM3 **Flexible and Grid-less Wavelength Selective Switch Using LCoS Technology**, Steven Frisken; *Finisar, Australia*

OWM4 **Integrated Optical Demultiplexer for Optical OFDM Signals**, Koichi Takiguchi; *NTT Photonics Labs, Japan*

OWV1 **Multilevel Optical Modulator with PLC and LiNbO3 Hybrid Integrated Circuit**, Hiroshi Yamazaki; *NTT Photonics Labs, Japan*

OWV4 **Polarization Multiplexed (D)QPSK InP Receiver Photonic Integrated Circuits**, Radhakrishnan Nagarajan; *Infinera, USA*

OWM1 **Polymer PLC as an Optical Integration Bench**, Norbert Keil; *Fraunhofer Inst. for Telecommunications, Heinrich Hertz Inst., Germany*

OThM4 **Silicon Photonic Components and Networks**, Michael Watts; *MIT, USA*

OThV1 Silicon Photonics Technologies for Monolithic Electronic-Photonic Integrated Circuit Applications, Dim-Lee Kwong; *Inst. of Microelectronics, Agency for Science, Technology and Res., Singapore*

Category 8. Optoelectronic Devices

OML1 100 Gb/s Photoreceivers for Coherent and Direct Detection, Heinz-Gunter Bach; *Fraunhofer Inst. for Telecommunications, Heinrich Hertz Inst., Germany*

OWZ1 High Performance Ge/Si Avalanche Photodiodes Development in Intel, Yimin Kang; *Intel Corp., USA*

OThG1 High Speed Photonic Crystal Vertical Cavity Lasers, Kent Choquette; *Univ. of Illinois at Urbana-Champaign, USA*

OWD1 High-Speed Modulation Lasers for 100GbE Application, Takashi Tadokoro; *NTT Photonics Labs, Japan*

OWQ1 Optical Interconnects in Future Servers, Jeffrey Kash; *IBM T. J. Watson Res. Ctr., USA*

OThY1 Photonic Integrated Circuits for Optical Routing and Switching Applications, Milan Masanovic; *Univ. of California at Santa Barbara, USA*

OThP1 Plasmonics for Signal Processing, Lars Thylen; *KTH Royal Inst. of Technology, Sweden*

OWQ6 Silicon Photonic Devices and Their Integration Technology, Koji Yamada; *NTT Microsystem Integration Labs, Japan*

OThP6 Tunable Slotted Fabry-Pérot Lasers for Agile Optical Networks, Liam Barry; *Dublin City Univ., Ireland*

Category 9. Digital Transmission Systems

OMI3 100G Transoceanic Length Transmission with High Spectral Efficiency Using Bandwidth Constrained PDM-QPSK, Jin-Xing Cai; *Tyco Electronics Subsea Communications, USA*

OThO1 Coded Modulation in Optical Communications, Henning Bülow; *Alcatel-Lucent Bell Labs, Germany*

OMR1 Linear and Nonlinear Impairment Mitigation for Enhanced Transmission Performance, Oriol Bertran-Pardo; *Alcatel-Lucent Bell Labs, France*

OWX2 Long-Haul Atmospheric Laser Communication Systems, Scott Hamilton; *MIT Lincoln Lab, USA*

OThF1 Mitigation of Nonlinearities in Optical Transmission Systems, Etsushi Yamazaki; *NTT Network Innovation Labs, Japan*

OWO7 Transmission Limitations due to Fiber Nonlinearity, Alberto Bononi; *Univ. di Parma, Italy*

Category 10. Transmission Subsystems and Network Elements

OTuE1 Bandwidth-Flexible ROADMs as Network Elements, Simon Poole; *Finisar Australia, Australia*

OWW1 Compensation of Nonlinear Effects Using Digital Coherent Receivers, Guifang Li; *Univ. of Central Florida, USA*

OWW4 Frequency-Domain Equalization for Coherent Optical Transmission Systems, Koichi Ishihara; *NTT Network Innovation Labs, Japan*

OMS1 Recent Progress on Real-Time DSP for Direct Detection Optical OFDM Transceivers, Robert Killey; *Univ. College London, UK*

OTuE6 The Convergence of L1/2/3 Functionality in Next Generation Network Elements: A Carrier's Perspective, Glenn Wellbrock; *Verizon, USA*

OWE1 Towards Real-Time CO-OFDM Transceivers, Fred Buchali; *Alcatel-Lucent, Res. & Innovation, Germany*

Category 11. Optical Processing and Analog Subsystems

OTuO3 10 Gbit/s Wireless Transmission Using Millimeter-Wave over Optical Fiber Systems, Andreas Stöhr; *Univ. Duisburg Essen, Germany*

OMK1 All-optical RAM Buffer Subsystem Demonstrator, Ken-ichi Kitayama; *Osaka Univ., Japan*

OThJ1 Atacama Large Millimeter Array Local Oscillator: How Photonics is Enabling Millimeter-wave Astronomy, Dorsey Thacker; *Natl. Radio Astronomy Observatory, USA*

OThW1 High-Power, Low-Noise Slab-Coupled Optical Waveguide (SCOW) Amplifiers and Lasers, Paul Juodawlkis; *MIT Lincoln Lab, USA*

OThW6 Nonlinearity and Phase Noise in High-Current Photodetectors, Curtis Menyuk; *Univ. of Maryland, Baltimore County, USA*

OThA6 Photonic Technologies for Antenna Beamforming, Moshe Tur; *Tel Aviv University, Israel*

OTuF1 Radio over Fiber Technology for Next-Generation E-Health in Converged Optical and Wireless Access Network, Arshad Chowdhury; *Georgia Inst. of Technology, USA*

OThA1 Transmit Isolating Photonic Receive Links: a New Capability for Antenna Remoting, Charles Cox; *Photonic Systems, Inc., USA*

OThJ6 Ultra-High Data-Rate 60 GHz Radio-over-Fiber Systems Employing Optical Frequency Multiplication and Adaptive OFDM Formats, Jason (Jyehong) Chen; *Natl. Chiao Tung Univ., Taiwan*

OMK6 Ultra-Low Power Optical Switches, Katsuyuki Utaka; *Waseda Univ., Japan*

Category 12. Core Networks

OWR4 Interaction Between Applications and the Network, Malathi Veeraraghavan; *Univ. of Virginia, USA*

OTuR4 Light-trails: Distributed Optical Grooming for Emerging Data-Center, Cloud Computing, and Enterprise Applications, Arun Somani; *Iowa State Univ., USA*

OThAA1 Optical Networking Trends and Evolution, Christoph Glingener; *ADVA Optical Networking, Germany*

OThR3 Optical Switch Architectures for Emerging Colorless/Directionless/Contentionless ROADM Networks, Richard Jensen; *Polatis, Inc., USA*

OWAA1 Terabits Networking for Extreme-Scale Science, Thomas Ndousse-Fetter; *Dept. of Energy, USA*

OWR1 The Non-Wireless Part of Cellular Networks: What's With the Backhaul?, Pete Magill; *AT&T, USA*

OTuR1 Traffic Types and Growth in Backbone Networks, Alexandre Gerber; *AT&T Labs – Res., USA*

OThR1 Transport Network Evolution: from TDM to Packet, Nabil Bitar; *Verizon, USA*

Category 13. Access Networks

OWB7 Changes in the HFC Architecture, George Bodeep; *ARRIS Intl., USA*

OTuB1 Coherent Optical Access Networks, Harald Rohde; *Nokia Siemens Networks, Germany*

OThB1 Energy-Efficient Optical Access Network Technologies, Junichi Kani; *NTT Access Service Systems Labs, Japan*

OThK5 Next-Generation Components for Optical Access Networks, David Piehler; *Neophotonics, USA*

OThT3 Over-Sampling based Burst-mode CDR Technology for High-speed TDM-PON Systems, Naoki Suzuki; *Mitsubishi Electric Corp., Japan*

OTuK3 Real-Time Optical OFDM Transceivers for PON Applications, Jianming Tang; *Bangor Univ., UK*

OWK1 Universal Gigabit Optical Access, James Kelly; *Google , USA*

Category 14. Datacom, Computercom, and Short Range and Experimental Optical Networks

OMW1 Cloud Computing over Telecom Network, Dominique Verchere; *Alcatel-Lucent Bell Labs France, France*

OThZ1 Compact and Low-Cost Optical Interconnection Employing Novel Small Multi-Fiber Optical Connectors, Shuichiro Asakawa;

OThH1 Enabling Energy Efficient Exascale Computing Applications with Optical Interconnects, John Shalf; *Lawrence Berkeley Natl. Lab, USA*

OThQ1 Optical I/O for Chip-to-Chip Interconnects on CMOS Platform, Peter Chang; *Intel Corp., USA*

OThH2 Optical Interconnection for High-Speed Router, Shinji Nishimura; *Hitachi Ltd., Japan*

OThQ2 Photonic Interconnection Networks for Multicore Architectures, Nathan Binkert; *Hewlett-Packard Labs, USA*

OWU1 Scaling Networks in Large Data Centers, Donn Lee; *Facebook, USA*

Plenary Session

Read exclusive interviews with Alan Gara IBM Fellow, Blue Gene Chief Architect and OFC/NFOEC Keynote Speaker and Clint Schow, Research Staff Member at IBM and OFC/NFOEC 2011 Computercom Symposium Organizer

Speakers

Alan Gara

IBM Fellow and Blue Gene Chief Architect, IBM T. J. Watson Research Center, USA

Presentation: Supercomputing's symbiotic relationship with advanced optics

Abstract: Gara's presentation titled, "Supercomputing's symbiotic relationship with advanced optics" will discuss the challenges of reaching computing at the exaflop level with special emphasis on areas where traditional communication solutions will not suffice. As in the past, optical technologies will be needed to address new scales of cost, power and performance density. Innovation in optics is critical to the success of future supercomputers. This results in supercomputers also serving as a breeding ground for advances and development in optical technologies that will migrate to the broader commercial market.

Biography: Dr. Alan Gara is the chief architect of the BlueGene supercomputer. He received his PhD in physics from the University of Wisconsin, Madison in 1987. Dr. Gara is a 1998 Gordon Bell recipient for the QCDOC machine, a custom supercomputer optimized for Quantum Chromodynamics. He joined IBM Research in 1999 and has been leading high performance computing architecture and design efforts.

Bruno Orth

Senior Vice President, Strategy and Architecture, Deutsche Telekom AG, Germany

Presentation: Surfing the Wave of the Gigabit Society

Abstract: Currently titled "Surfing the Wave of the Gigabit Society," Orth's presentation will discuss the future data- and media-centric world with a particular emphasis on the challenges it presents for network operators. Additionally, Orth will cover network transformation and strategy and practical examples of how to enable efficient broadband. Orth will also talk about Deutsche Telekom and their vision for the future.

Biography: Bruno Orth was born in July 1957 in Ludwigshafen, Germany. He started his professional career in the area of ISDN.

Since 1985 he was responsible for various technology topics within Deutsche Bundespost and later at Deutsche Telekom AG. Bruno Orth was in charge of different strategic and technical concepts for access networks like narrowband FTTH and ADSL.

As member of International Telecommunication Union (ITU-T) Study Groups 13 & 15 and as chairman of Technical Committee 3 of the European Telecommunications Standards Institute (ETSI TM3), he was involved in various activities to ensure industry-wide standards for ac-cess and transmission architectures.

Since January 1, 2010, Bruno Orth has been responsible for strategic questions in the area of network technology including international standardization and technology-related IPR management.

Kristin Rinne

Senior Vice President – Architecture & Planning, AT&T, USA

Presentation: Building Next Generation Mobility Networks – Lessons from the Bonneville Speedway

Abstract: Rinne's presentation will share insights into the explosive growth of mobile data and how that growth impacts optical networks including cell site backhaul. She will also discuss the evolution from HSPA to LTE.

Biography: Kris Rinne is responsible for wireless industry standards development, long range technology planning, and the network and device planning for new products and services for wireless at AT&T. She also has broader network architecture responsibility for the corporation as a whole.

Prior to this position, Rinne served as Cingular's chief technology officer with similar responsibilities. She earlier served as vice president–Technology and Product Realization,

responsible for new product development from a technology standpoint, handset certification, and infrastructure vendor coordination.

Prior to joining Cingular, she was vice president–Technology Strategy for SBC Wireless, responsible for new product development and network operations support. She has worked for Southwestern Bell Mobile Systems as managing director—Operations.

Market Watch Panel Sessions

Tuesday, March 8 –Thursday, March 10, 2011
OFC/NFOEC Exhibit Floor Theater

This three-day series of panel sessions engages the applications and business communities in the field of optical communications. Presentations and panel discussions feature esteemed guest speakers from industry, research and the investment communities.

The program will be located on the exhibit floor, so attendees can easily attend the sessions and tour the exhibit hall. Audience members are encouraged to participate in the question and answer segments that follow the presentations.

Market Watch Chair:
Karen Liu, *Vice President, Components and Video Technologies, Ovum, USA*

Market Watch Organizer:
Samuel Liu, *Director, Product Line Management, Opnext, OPS Business Unit, USA*

Schedule-at-a-Glance
Panel descriptions and speakers are being confirmed so check this site often for program updates.

Tuesday 12:00 p.m.–2:00 p.m.	Panel I: State of the Optical Industry Moderator:Richard Habel, *M.Sc., CEO, Habel Consulting, Canada*
Tuesday 3:00 p.m.–5:00 p.m.	Panel II: Implications of Converged Wireline Wireless for Network Evolution Moderator:Dana Cooperson, *Vice President, Network Infrastructure, Ovum, USA*
Wednesday 1:00 p.m.–3:00 p.m	Panel III: 100G Ecosystem: Enabling Technology and Economics Moderator:James Keszenheimer, *Ph.D., M.B.A, Business Development Manager, ViaSat-Cleveland, USA*
Thursday 10:00 a.m.– 12:00 p.m	Panel IV: Data Center: Traffic and Technology Drivers Moderator:Vladimir Kozlov, *Founder and CEO, LightCounting LLC, USA*

Thursday 1:00 p.m.– 3:00 p.m.	Panel V: What's Next for Optical Networking Moderator:Andrew Schmitt, *Directing Analyst, Optical, Infonetics Res., USA*

Panel I: State of the Optical Industry

Tuesday, March 8, 2011
12:00 p.m.–2:00 p.m.

Moderator:

Richard Habel, *M.Sc., CEO, Habel Consulting, Canada*

Richard Habel has over 25 years of optic and telecommunications experience, with expertise in financing, business development, and R&D. In 2009, Mr. Habel founded Pavemetrics Systems Inc., a company focused on the commercialization of vision systems. He also works as a consultant for venture capital firms specializing in high technology and he is on several boards of directors.

Mr. Habel founded IPR Due Diligence, a consulting firm in the field of intellectual property. He was vice president of the tunable components business unit at JDS Uniphase, where he managed a staff of over 160 people. Mr. Habel also spent 12 years with Nortel Networks' high capacity development group in the development of OC-48, OC-192, and next-generation optical systems.

Mr. Habel holds a M.Sc. in electrical engineering from Laval University, Quebec City, Canada. He holds 23 patents and is a regular presenter at industry conferences, authoring several technical papers

Panel Description:

The goal of this session is to provide views from carriers/service providers, equipment & component suppliers, VC/financiers, and market and equity researchers on industry health, consolidation, funding innovation, etc.

Speakers:

Paul A. Bonenfant, *Communications Components Analyst, Vice President - Equity Research, Morgan Keegan & Co., USA (A note on Paul Bonenfant)*

Optical Networks 2011 and Beyond: The Hot and the Not

Dana A. Cooperson, *Vice President, Network Infrastructure, Ovum, USA*

What's happening with network infrastructure at the optical systems level? How are buyers' requirements changing, and how are vendors rising to the challenge posed by disconnects and shifts in telco business models? What opportunities beckon as a result of packet-optical and fixed-mobile convergence, and what minefields may be lying in wait? This presentation will focus on what's hot and what's not in optical networking.

Dana brings 15 years of telecoms vendor and service provider experience to her 11 years as an industry analyst. Prior to joining RHK/Ovum, Dana was a marketing manager for Tektronix, where she managed WDM/SONET/SDH test and measurement products. Before Tektronix, she managed MX3 and SONET products at Telco Systems. She began her career as a network engineer at NYNEX (now Verizon Communications) in New York City. Dana was awarded an MS in management from MIT and a BS in engineering from Cornell University.

New Architectures in Optical Networking

Eve Griliches, *AGC Research*

How Content Providers are changing the dynamics of optical networking. We'll examine the market dynamics, architectural changes and next generation plans which will affect the overall optical market revenues.

Using extensive experience in product management in the technology industry as her foundation, managing partner Eve Griliches brings to ACG a demonstrated analytical talent bolstered by years of hands-on experience in the telecommunications industry. Her analytical acumen, expertise and experience in the telecom field as well as her strong management skills have made her a highly credible voice in the industry. She is respected worldwide for her market share reporting and forecasting for the networking and telecommunications industries and organizations. With her combination of strategic marketing and analytical experiences, Eve will use her tactical communication expertise as well as her comprehensive understanding of IP technology to focus on the convergence of IP and Optics. Ms. Griliches, who has a reputation for delivering accurate and timely market information, leveraging advanced technology and staying focused on client care and customer service, spent five years at IDC as Program Director for the Telecommunications Equipment group. She provided in-depth insight and analysis on many of the key technologies in the telecom market. Ms. Griliches also provided critical business intelligence on emerging technology trends and their impact on the overall telecom market space. Ms. Griliches also has over 10 years of product management experience with a number of network equipment vendors. Those vendors include: Marconi (Ericsson), PhotonEx, Nortel Networks, Bay Networks, and Wellfleet. Additionally, she spent four years at Thinking Machines Corporation, one of the first parallel processing supercomputer companies.

Optical Transport: Network and Technology Evolution

Paul Littlewood, *Senior Network Architect, Ciena, USA*

Paul Littlewood is a Principal Engineer in the CTO team at Ciena and has

responsibility for building network vision, detailing next generation network architecture, and defining product application values. Paul joined Ciena in 2010 from Nortel where he was Leader of Carrier Network Architecture. Previously he has led product management and engineering teams to bring to market optical transport and digital cross connect products. He has also led in the definition and introduction of Carrier Ethernet technologies such as Resilient Packet Ring. Paul has seven patents and has an Honours Degree in Pure Physics from the University of Newcastle upon Tyne in the UK. He is based in Atlanta, Georgia, USA.

State of the Industry---Of the Future?
Peter Magill, *AT&T*

Beyond the state of today's telecommunications industry, this talk will offer some thoughts on where technology may be heading, including each of the Inter-city, Metro and Access network segments. In the Access arena, mobility is quickly becoming very important. What can the optical community do about it? Metro would benefit from recent advancements in long-haul transponders and ROADMs, but only at reduced price-points (and with reduced requirements). For Inter-city transport, the talk will explain why some proposed technology advancements are valuable while others are not. Finally, it will cover technology advancements in components and sub-systems, since many of the system-level improvements are rooted there.

Peter Magill received his B.S. in Physics from the University of Dayton, Ohio in 1979 and his Ph.D. in Physics from the Massachusetts Institute of Technology in 1987. He then joined AT&T Bell Labs at the Crawford Hill Lab on the characterization of advanced lasers, optical access networks and data-over-cable access protocols. He transferred with Lucent Technologies as it was spun out of AT&T in 1996, to head their access research department. He managed the R&D of passive optical network (PON) systems and cable modem headend equipment. In 2000 he returned to AT&T and is now Executive Director, Optical Systems Research in Middletown, NJ concerned with advancing fiber communication technologies for the entire network (inter-city, metro and access) including high-speed transmission systems (100 Gb/s and beyond) and dynamic-wavelength networks. Since 2007 he has been working on assessing, with a goal of reducing, AT&T's electricity consumption.

The Optical Reboot
Andrew Schmitt, *Directing Analysis, Infonetics, USA*
Take a brief excursion through the world of optical to see where investment is flowing, and why. I'll cover key trends such as the 100G market opportunity, ROADM spending, and low-latency optical networking.

Andrew Schmitt leads Infonetics Research's Optical coverage, authoring quarterly market share and forecast reports, regular research notes, and service provider survey research. He covers the optical market from the carrier, equipment, and components sides, tracking SONET/SDH, MSPP, crossconnects, WDM, ROADMs, packet

optical transport, 10G, 40G, 100G+, metro and long haul optical, etc. He is also a consultant to startups, service providers, manufacturers, and the investment community.

Prior to joining Infonetics, Andrew ran Vitesse Semiconductor's carrier chipset unit, and headed Nyquist Capital, an investment advisory and consulting firm focused on the optical sector. He holds multiple patents and earned his B.S. in electrical engineering at the University of California at Santa Barbara.

Panel II: Implications of Converged Wireline Wireless for Network Evolution

Tuesday, March 8, 2011
3:00 p.m.–5:00 p.m.

Moderator:

Dana Cooperson, **Vice President, Network Infrastructure, Ovum, USA**

Dana Cooperson is responsible for managing Ovum's networks research advisory and consulting services, which comprise broadband access, switching/routing, optical transport, mobile infrastructure, and carrier financials. Recent custom research projects have covered mobile network traffic management and optimization, test outsourcing in the mobile ecosystem, software product opportunities in ON, green networking, GPON opportunity analysis, EMEA and AP optical and carrier Ethernet opportunity analysis, and Ethernet services market entry planning.

Dana brings 15 years of telecoms vendor and service provider experience to her 11 years as an industry analyst. Prior to joining RHK/Ovum, Dana was a marketing manager for Tektronix, where she managed WDM/SONET/SDH test and measurement products. Before Tektronix, she managed MX3 and SONET products at Telco Systems. She began her career as a network engineer at NYNEX (now Verizon Communications) in New York City. Dana was awarded an MS in management from MIT and a BS in engineering from Cornell University.

Panel Description:

This panel looks at the interplay between the optical network and all things mobile. Fiber backhaul continues to increase in importance, but microwave and copper remain important, too. 3G mobile network and service rollouts continue, and LTE/ mobile WiMAX deployments have begun that aim to offer speeds that rival wireline broadband with fiber access. Emerging and developing markets have very different needs. Both wireless and wireline networks evolve to

become IP-centric, which creates the possibility of equipment platforms that serve both. And of course, the need for reliability and security and for scalability across multiple dimensions will not abate. What does all this mean to optical communications? We aim to unravel at least a few threads during this panel.

Speakers:

Simplify and Converge Wireline and Wireless Networks with Packet Optical, Bert Beuscher, *Tellabs, USA*

Fixed Mobile Convergence: End-to-End System Vendor's Perspective

Tricci So, Director, Advanced Research for the 4G Wireless End-to-End System, ZTE USA Inc.

This talk will focus on fixed-mobile convergence. Topics include what does FMC mean for operators, and what are their strategies to accomplish FMC; example deployment scenarios and challenges; example architectures (from 3GPP and BBF perspectives); example end user FMC service offerings; and system vendors' strategies.
Tricci So's current position is the Director of ZTE Advance Research for 4G E2E System, and she is also acting as the Network Solution Advisor for ZTE 4G technical marketing. Tricci has represented ZTE to work with many wireless operators around the world to promote ZTE's next generation broadband wireless multi-mode product solution for WiMAX and LTE, to support the trial and to solicit their network requirements. On the advance research side, before this year 2011, Tricci led the ZTE standard development team to actively participate in WiMAX Forum and was key contributor to WiMAX standard development. Tricci herself has chaired the technical development teams in the WiMAX Networking Working Group for the Wireless Broadband Multicast Broadcast Services and also for the VoIP over WiMAX specifications. Tricci is now representing ZTE to participate in 3GPP LTE work, especially focusing on Fixed/Mobile Convergence, Multi Radio Technologies Access and other key work items in SA2. Prior to joining ZTE, Tricci was the lead system architect for E2E WiMAX product solution for Nortel. Before WiMAX, Tricci also the lead system architect for the E2E 802.11-based Wireless Mesh product solution for Nortel. In addition, Tricci was key contributor for IEEE 802.11s standard specification. In addition to the broadband wireless end-to-end solution experience, Tricci has also been working on product development as well as standard development on numerous wireline technologies such as ATM, Frame Relay and Ethernet in her earlier careers. Tricci was graduated from University of Waterloo, Canada with the Bachelor of Honour degree in combined Mathematic and Computer Science.

Optical Technologies for Wireless Transport Networks in Emerging Markets

Harmeet Singh, *Sr. VP Business Development, Tejas Networks, USA*

Service Providers in emerging markets are experiencing a surge in transport bandwidth requirements, mainly driven by smart phones, USB wireless modems and still fast growing voice customer base. Such mixed applications are forcing the carriers to offer 3G/4G services and aggressively grow the 2G install base while facing a shrinking ARPU (average revenue per user). This presentation will discuss the new optical technologies and strategies for convergence of service types (Ethernet/TDM) and transport media (wireless/optical) being deployed by the carriers in emerging markets keeping them ahead in the revenue/cost equation.

Harmeet Singh has over 15 years of experience in general management, product management and R&D at industry leading companies such as Tejas Networks, Optovia, Nortel Networks, Qtera Corporation and 3M Corporation. He holds a Bachelor's degree from Indian Institute of Technology (IIT) Kanpur, India, a Doctorate from University of Maryland, College Park and has an Executive Education in Finance from Harvard Business School.

The IP Network Becomes a Business Differentiator

Matthew Smith, Head of Network Marketing, *Ericsson IP & Broadband, USA*

We are moving into the era of the Networked Society, where anything that will benefit from a connection will get one. Operators face both opportunity and threat from the combined force of the popularity and proliferation of a wide variety of smart devices, video/OTT and the rush to the cloud. Through progressive generations of Mobile broadband technology to LTE; the backhaul, transport and edge/core network has adapted to respond to the differing challenges: be they capacity, application or device specific. This talk will focus on how the whole IP network can now be refreshed to become the strategic differentiator that enables network operators to cope with the changed business climate. Covering technology trends in the Radio Access, Backhaul (Fibre access, Microwave advances), Mobile Core and fixed Edge, and of course, the optical transport segment (including unified MPLS), this presentation will show how a 4th generation IP network will enable operators to deliver differentiated, personalized services from a simpler, smarter and more scalable IP infrastructure.

With over a decade of Telecoms vendor experience, Matthew is currently responsible for Ericsson's vision on IP Networking: ranging across segments such as: Optical & Microwave Transport, Mobile Backhaul, Carrier Ethernet, IP Routing, Mobile Core, and Broadband Access. For the 5 years leading up to his move to the US in early 2010, Matthew had led the Optical Product Marketing function for Ericsson and Marconi, and prior to that had held various roles in Product Line Management. Matthew graduated from Loughborough University in 2000, and in his early years as a product manager he drove the introduction of NG-SDH, Ethernet technologies to the market-place. Throughout his career (which included a spell of two years

working in Sweden with some dedication to Mobile Backhaul) Matthew has focused on aiding operators with their migrations to packet-based technologies. Matthew is based in San Jose, California, at Ericsson's Silicon Valley campus.

Converging on Opportunity: Technology Implications for Evolving Mobile Backhaul and Broadband Services
James Anthony, Principal Solutions Architecht, Packet Optical Networking, *Fujitsu Network Communications*

As bandwidth requirements continue to increase for residential, commercial, and mobile services, the underlying network infrastructure must both scale to meet these requirements and achieve operational and capital expense efficiencies to stay profitable. Next-generation service architectures are being deployed to satisfy expanding 3G and 4G wireless networking, as well as increased commercial service offerings. This presentation will discuss the migration from TDM to Ethernet, scalability for 4G mobile backhaul, and the growth of additional commercial service types, with a focus on leveraging existing resources and operational structure.

James Anthony is a principal solutions architect, packet optical networking at Fujitsu Network Communications. He is responsible for business development and product strategy on packet optical networking solutions. James' role focuses on architecting specific solutions in response to customer requirements. Prior to joining Fujitsu, James was responsible for Carrier Ethernet transport strategy and business development at Nokia-Siemens, following their acquisition of Atrica, where he was product line manager for the Carrier Ethernet product line. He has also worked in technical leadership roles at Cisco, Alcatel and MCI. James holds a Bachelor of Science in Electrical Engineering from the University of Illinois at Urbana-Champaign.

Panel III: 100G Ecosystem: Enabling Technology and Economics

Wednesday, March 9, 2011
1:00 p.m.–3:00 p.m

Moderator:

James Keszenheimer, *Ph.D., M.B.A, Business Development Manager, ViaSat-Cleveland, USA*

Dr. James Keszenheimer is responsible for new business development and market strategy for the ASIC and IP Cores business of ViaSat, which sells DSP and FEC cores for 100 Gbps transport networks. He was previously business

director of the Optoelectronics Division at Sarnoff Corporation and has cofounded two photonics companies, Micracor and Novalux. Dr. Keszenheimer has consulted in areas including design, package and test, laser reliability for space missions, and FDA approved design and integration for medical devices. He holds B.S. and M.S. degrees in physics from John Carroll University, a Ph.D. in electrical engineering from Tufts University, and an M.B.A. from Myers University.

Panel Description:

This session will explore the state of the 100G ecosystem and expectations for its commercialization. As the first 100G networks are finishing field trials, speculation continues about the readiness of the technology, cost effectiveness, market acceptance, and timing for deployment. Will the lessons learned from 40G enable 100G to take off sooner? How will technology convergence in modulation formats affect future data rates beyond 100G? Will OFDM become a viable solution and what other solutions including higher order modulations will likely surface?

Speakers:

100G Commercial Deployments: Experiences, Current Status, and Prospects

Joe Berthold, *VP Network Architecture, Ciena, USA*

It has now been more than one year since the first commercial deployment of 100G DWDM transmission systems and much longer since early system demonstrations and field trials began. Even so, from the perspective of the broad industry, we are still in the early stages of 100G adoption. In this talk we will review our experience with commercial deployment of 100G systems and provide our perspective on the status of the 100G ecosystem, ranging from user demand to technology readiness and attractiveness. We will also offer some observations on the ways the technology introduced for 100G will change the way networks are designed and operated. Finally we will look to the next step of evolution, for channel rates beyond 100G.

Joseph Berthold is Vice President, Network Architecture at Ciena, where he has worked since 1997. There he contributes to the understanding of future network architecture directions and is responsible for coordination of Ciena's work in industry standards. He is a member of the Board of Directors of ATIS (Alliance for Telecommunications Industry Solutions). He chaired the Technical Committee of the Optical Internetworking Forum from 1998-2001, and was its' President from 2002-2007. More recently he served as Editor of the OIF 100G Framework Document. He has been a long-term contributor to OFC/NFOEC was the Technical Program Co-chair for 2001 and the General Co-Chair for 2003. He is a Fellow of the IEEE. Prior to Ciena he held various research and development positions at Bell Labs and Bellcore from 1977-1997. He

received a PhD in Physics from Brown University in 1976, and did postdoctoral research at Cornell University from 1975-1977.

Impact of 100G Technology on System and Network Design: A Stimulus for Convergence

Jeffrey Maddox, *Senior Director, Product Line Management, Optical Transport Business Unit, Cisco Systems, Inc., USA*

The growth in demand of 100G optics is poised to have a dramatic impact on the way operators deploy optical and packet systems. The 100G technologies play such a fundamental role in scalability of high bandwidth services that it is expected that this will in fact be a stimulus for dramatic convergence of IP and Optical Technologies and subsequently pave the way for networking products with a much higher level of cross engineering than we've seen to date.

As Sr. Director of the Optical Transport Business Unit's product line management group, Jeffrey Maddox is a member of the leadership team implementing Cisco's vision and strategy for next generation optical networking. Cisco's optical team introduced the industry's first next-generation multiservice transport platform (MSTP) and led the growth to #1 marketshare worldwide for deployment of ROADM technologies. Today, the MSTP DWDM product is the cornerstone of Cisco's IP over DWDM strategy, which is changing the way service providers, cable operators, and enterprise companies build their networks. The MSTP products are the convergence point of Packet, Optical, OTN and TDM technologies. Mr Maddox has more than 16 years of experience in the telecommunications industry. Prior to Cisco, he worked at Nortel Networks. He received a bachelor's degree in electrical engineering from McMaster University in Canada.

DWDM Line Side Technology Evolution

Ross Saunders, *VP Marketing, Opnext Subsystems Inc., USA*

This presentation will describe technological developments in high speed DWDM optical transport and their application into carrier networks. Optimized technologies from a price/performance/feature standpoint will be addressed for different target markets such as metro/regional/long haul/submarine applications. Emerging trends and market adoption for 40G/100G will be discussed as well as forward-looking view to advanced technology beyond 100G data rate.

Ross Saunders worked in Nortel Networks high capacity transport R&D group for 6 years on 10Gb/s, 40Gb/s and 100Gb/s DWDM system design. Over the last 12 years, he has spent time working in DWDM Product Management for Nortel Networks, Pirelli Optical Systems (now Cisco), Ceyba Inc and Opnext Subsystems (formerly StrataLight Communications). Ross currently runs Marketing for Opnext Subsystems. He graduated BENG degree from Napier University, Edinburgh, and has 18 US patents granted in optical communications and approximately 100 journal/conference papers published to date.

Is 100G at Our Fingertips?

Terry Unter, *President and General Manager, Optical Network Solutions BU, Oclaro Inc., USA*

Dates ranging from 2011 to 2015 have been published in various media as the 'year for 100G'. Clearly there is a wide range of views regarding the readiness of 100 Gbps across the industry. This talk will focus on: the key ingredients for a successful 100 Gbps product, the current status of these ingredients and the steps involved between transponder module readiness and network deployment leading to an overall timeline from today to wide scale 100 Gbps deployment. Looking beyond 100 Gbps to 400 Gbps and1 Tbps, it is clear that further innovations beyond today's technology toolbox are required; and a look ahead into this future will be discussed.

Dr. Unter is Executive Vice President and General Manager of Oclaro's Transport Systems Solutions business unit. He assumed this position in July 2010 as a result of Oclaro's acquisition of Mintera Corporation (a leading supplier of high bit-rate optical transport solutions) where he was President and CEO from 2004 to 2010. From 1998 to 2002, he was Chief Operating Officer at Corvis Corporation before which he served as Vice President of Global Optoelectronics at AMP Incorporated. From 1991 to 1997 he led the creation of Alcatel's Optronics subsidiary, where he served as its CEO based near Paris in France. Earlier in his career Dr. Unter was General Manager of a joint venture producing telecom VLSI circuits in China, and he also held various engineering and management positions with NorTel and Alcatel. Dr. Unter holds B.Sc. (honors) and Ph.D. degrees in Electronic Engineering from Southampton University in the UK.

100G Networks - Challenges for semiconductor vendors and solutions

Markus Weber, *Director Wireline, Fujitsu Semiconductor Europe, Germany*

The modulation format standardized for 100G coherent transmission placed significant challenges on semiconductor suppliers; to combine extremely high performance analogue circuits and complex digital signal processing in a single CMOS chip. Until 2009, the general view was that this was not feasible using currently available process nodes and a commercially acceptable system was still several years away. By using innovative analogue techniques and co-design of chip/package and printed circuit board, and combining this technology with other key components of the ecosystem, such as modulators, receivers and oscillators, 100G transmission systems were launched in 2010. Even more complex modulation and/or higher baud rate for 400G and beyond can be supported once the market identifies the need.

Markus Weber is responsible for the wireline products of Fujitsu Semiconductor Europe. This activity also includes business development and strategic partnerships for products using Fujitsu's CHAIS based high-speed ADC and DAC technologies enabling 100G coherent transceivers. Markus was previously involved in standard product development for 40G OTN networks. He holds a master’s degree in computer science from the Technical University of Kaiserslautern.

Panel IV: Data Center: Traffic and Technology Drivers

Thursday, March 10, 2011
10:00 a.m.– 12:00 p.m

Moderator:

Vladimir Kozlov, *Founder and CEO, LightCounting LLC, USA*

Dr. Vladimir Kozlov is the founder and CEO of LightCounting, an optical communications market research company. LightCounting was established in 2004 with an objective of providing in-depth coverage of market and technologies for high speed optoelectronic interfaces employed in communications. By now, the company employs a team of industry experts and offers comprehensive coverage of the optical communications supply chain.

Dr. Kozlov has more than 20 years of experience in optoelectronics, optical communications, and market research. Dr. Kozlov held market analyst, product development, and research staff positions at RHK Inc., Lucent Technologies, and Princeton University. Dr. Kozlov holds several US patents and has numerous publications in the area of optoelectronics. He received his M.Sc. at Moscow State University in Russia and a Ph.D. in physics at Brown University in the United States.

Panel Description:

With global economic recovery underway, deployments of new enterprise datacenters and upgrades to the existing ones are accelerating. Emergence of Super Datacenter operated by popular content providers like Amazon, Facebook and Google gives another boost to this market. Continuing migration to virtualized datacenters and cloud computing makes the situation even more interesting.

The panel will focus on addressing the following issues:

- How changes in datacenter design impacting requirements to optical interfaces?
- What limits growth of Super Datacenters?
- Is there an opportunity for new optical technologies?
- How datacenter managers navigate through technological changes and battles among major equipment vendors?

Speakers:

To be Announced, Adam Carter, *Director, TMG Cisco, USA*

To be Announced, Andy Ingram, Vice President, Product Marketing and Business Development, Fabric and Switching Technologies Juniper Networks, USA

Andy Ingram has more than 25 years' experience in the high-tech industry bringing ground-breaking technology to market. In his current role, he is responsible for driving the marketing and go-to-market strategies for Juniper's Fabric & Switching Business Group. Andy joined Juniper in October 2008 from IGT, where he was the Senior VP of Network Systems. Prior to IGT, Andy held various senior management positions at Sun Microsystems, Hewlett Packard, Cray Research and Sequent Computers, involved in the marketing and sales of servers, storage, system software, security products and application software. Andy holds an MBA from the Anderson School at UCLA , a bachelor degree from the University of Colorado, and a CPA license in California.

Data Center Drivers and Needs
Donn Lee, *Sr. Network Engineer, Facebook Inc., USA*

This talk will cover drivers, needs, and constraints of Internet Data Centers with reference to optical networking and optical devices.

Donn Lee is a Sr. Network Engineer at Facebook. His duties include designing networks, evaluating products, optimizing performance, and performing escalation troubleshooting. Previous to Facebook, Donn worked in Google's Network Architecture group for four years and during tremendous growth of Google's backbone, optical, and datacenter networks. While working as a Consulting Systems Engineer at Cisco Systems (CCIE #3262) he worked on large global networks and wrote his book, Enhanced IP Services for Cisco Networks, that is published by Cisco Press. He holds a bachelor's degree in Electrical Engineering from UCLA.

Megatrends in the Datacenter: Convergence of Networking, Security and Storage Technologies
Jane Li, *General Manager, North America Market, Huawei-Symantec, USA*

We are at an inflection point in the IT industry that is motivating suppliers to incorporate the megatrends of virtualization and cloud computing into their datacenter roadmaps. Virtualization and cloud computing require a unique configuration that is driving a convergence of networking, security and storage technologies. The resulting higher data rates and improved bandwidth will interest component suppliers as well.

Jane Li is General Manager, NA Market for Huawei Symantec (HS). In her current role, she is driving the strategy and execution for HS' North American expansion. Her functional

responsibilities include Marketing, Sales, Business Development, Product Management, Application Engineering and Customer Services for the North American Region. Huawei Symantec is a joint venture between Huawei and Symantec. Main products include storage, security and networking equipments for the enterprise market. HS was established in 2007 and has been growing at a rapid pace since its establishment. Li received a master's degree in Communications and Marketing from Ohio University. She also holds BS and MS degrees in Telecommunications Engineering from Zhejiang University. Li was a member of the National Board of Directors for Women in Cable & Telecommunications (WICT).

Comparison of Links in the Data Center, Scott Kipp, *Brocade, USA*
Data Center links are measured on the main criteria of cost, power, latency, distance and speed. This presentation will compare the various 10GbE, 40GbE and 100GbE links on these criteria and show the main application of these links in topologies being used in modern data centers with focus on Internet Data Centers. The presentation compares 10GBASE-T to optical links and 100GBASE-LR4 to the 10x10 CFP. The results show how certain types of links have inherent advantages due to how standards were written and the media that they use.

Scott Kipp represents Brocade in multiple standards organizations and has written several books on storage networking and fiber optics. Scott contributes to multiple standards organizations including ANSI T11, IEEE 802.3, OIF, IEEE 1619, SNIA, OASIS, IETF and Multi Sourcing Agreements. He specializes in high-speed fiber optic technology. Kipp has written three books for the Fibre Channel Industry Association (FCIA), another entitled Broadband Entertainment and co-authored the Handbook on Fiber Optic Data Communications. He has a Bachelors and a Masters degree in Electrical Engineering from Cal Poly in San Luis Obispo, California.

Panel V: What's Next for Optical Networking

Thursday, March 10, 2011
1:00 p.m.– 3:00 p.m.

Moderator:

Andrew Schmitt, *Directing Analyst, Optical, Infonetics Res., USA*

Andrew Schmitt leads Infonetics Research's Optical coverage, authoring quarterly market share and forecast reports, regular research notes, and service provider survey research. He covers the optical market from the carrier, equipment, and components sides, tracking SONET/SDH, MSPP, crossconnects, WDM, ROADMs, packet optical transport, 10G, 40G, 100G+, metro and long haul optical, etc. He is also a consultant to startups, service providers, manufacturers, and the investment community.

Prior to joining Infonetics, Andrew ran Vitesse Semiconductor's carrier chipset unit, and headed Nyquist Capital, an investment advisory and consulting firm focused on the optical sector. He holds multiple patents and earned his B.S. in electrical engineering at the University of California at Santa Barbara.

Panel Description:

This session will look at the challenges service providers face in the coming years and how suppliers plan to help them surmount them. Panelists are encouraged to focus on "what's next," not "what we've done," present what they expect to be the toughest issues that need resolution in coming years, and what they think the best path to success is. Topics to be discussed – 100G Coherent networking roadmaps, ROADM roadmaps, and Packet-Optical Networking architectures.

Speakers:

Next Generation Terabit Networking, Edward Englehart, *WDM Portfolio, Alcatel-Lucent, USA*

The challenge facing researchers is to chart the future of high speed networking and put the first strategic building blocks in place beyond 100G. Traditional network providers are rethinking their deployment plans and moving quickly to transform their networks in the search for a way to ease the strain on their networks while maintaining superior performance to manage a strong increase in traffic demand by leveraging 100G and beyond coherent technology, All this to achieve cost efficient high-capacity transport and network resource optimization over a converged network. Although there is currently no forecast for network deployments at rates higher than 100 Gbit/s in the very near terms, it is still the right time to think about development of such networks creating a disruptive innovation that would change the paradigm. Moving fast to realize early prototypes will secure an advantage by demonstrating technical leadership and shaping customer requirements and influencing standardization bodies.

Transport: Diverging or Converging on Ethernet?
Edward Doe, *Broadcom, USA*

As Transport technology evolves many solutions (Hybrid Optical/Packet systems, Next Gen OTN switches, Packet Only Transport Nodes, …) are emerging, each with a different approach, history and perspective. While it is tempting to view these myriad solutions as a sign of segmentation and divergence in the market, what we are really experiencing is a convergence of approaches over one common technology: Ethernet. This presentation will examine different transport technology solutions and discuss what the industry can expect to see in the near future. The presentation will also discuss how Network Operators and Telecom Equipment Manufacturers (TEMs) can distill the commonality between with various transport solutions, and be ready for a proliferation of platforms and the final technology convergence.

Edward Doe serves as Senior Product Line Manager for the Infrastructure & Networking Group (ING) at Broadcom Corporation. In this role, Doe is responsible for Service Provider product management in the StrataXGS Product Line. Doe has served in a variety of product management roles during his six years of tenure at Broadcom, focused on markets from Service Provider to Data Center and Enterprise Networking and has taken part in several key acquisitions in the Networking space. Prior to Broadcom, Doe served at Nortel and Bay Networks in various technical and business leadership roles, focused on next generation Ethernet/IP switch systems and associated technologies. Doe attended Stanford University for his graduate studies in Electrical Engineering, and holds a Bachelor's degree in Electrical Engineering.

The Challenges of Future Data Rates to the Wavelength Routing Architecture
Steve Frisken, *CTO, Finisar Australia Pty Ltd*

For the first time in history, realistically envisaged optical networks are edging towards fundamental transmission capacity constraints within the existing amplification bands. The wavelength-routing network elements such as ROADMs will have to respond as much as the next generation of transceiver technology. The network operators are considering increasing the optical flexibility in the future networks including: grid-free switching; high spectral efficiency; low latency; enhanced direction-free connectivity; high-speed reconfiguration for provisioning and restoration. How will the physical-layer switching respond to this wish-list? This forum will review whether the functional advantages are significant, and what the implications are for the control plane. The optical layer is already gearing up for the new requirements with Liquid Crystal on Silicon wavelength switches demonstrating capabilities to be configured to a flexible channel Grid.

Steven Frisken is a graduate of theoretical physics with 20 years experience in the optical communications and photonic components industry. Steve Frisken was a co-founder of Photonic Technologies in 1993 where he successfully commercialized technology that culminated in the acquisition of Photonic Technologies by Nortel Networks in May 2000. His achievements at Photonic Technologies included the first introduction of a telecommunications-style optical circulator---the design of which has been widely adopted in the industry--and dynamic EDFA gain flattening filters. Following the collapse of the Telecom bubble in late 2001, Steve teamed up with Index/JDSU founder Simon Poole to form Engana, with a mission to create optical modules for future flexible optical networks. He is now the CTO of Finisar Australia and his current research interests include high-speed coherent transmission systems, contention-free wavelength switching architectures and swept-laser systems for biomedical imaging applications.

Packet Optical Architectures: An XO Communications Perspective, Randy Nicklas, *CTO, XO Communications*

Preparing for the Future
Glenn Wellbrock, *Director of Optical Transport Network Architecture and Design, Verizon, USA*

Given that current generation DWDM systems supported multiple bit rate upgrades, the expectation is that next generation platforms will provide even more scalability. This presentation focuses on key requirements to future proof the transport network.

Glenn Wellbrock is the Director of Optical Transport Network Architecture and Design at Verizon, where he is responsible for the development of new technologies for both the metro and long haul transport infrastructure. Previous positions include running the advanced technology lab, establishing evaluation criteria, and setting engineering guidelines for all backbone transport equipment as well as various positions within network operations. In addition to his 20+ years at Verizon (1984-2001 & 2004-present), Glenn was responsible for Product Architecture within the USA focused optical networks group at Marconi and Product Planning at Qplus Networks with a specific focus on developing alternative modulation techniques.

Ed Englehart leads the Product Management team for the WDM portfolio at Alcatel-Lucent. In his 25 years of experience he has worked in key areas of Optics, Enterprise, and Access with a key focus on service provider and enterprise customer solutions. He has held leadership positions in R&D, System Engineering and Product Line management. Ed holds a Masters degree in Electrical Engineering from Columbia University.

Service Provider Summit

Wednesday, March 9, 2011

OFC/NFOEC Exhibit Floor Theater

The Service Provider Summit is open to all Conference Attendees and Exhibit Pass Plus Attendees! Join your colleagues for this dynamic program with topics and speakers of interest to CTOs, network architects, network designers and technologists within the service provider and carrier sector. The program includes panel discussions, a keynote presentation, exhibit time and networking time.

The program will be located on the exhibit floor, so attendees can easily attend the sessions and tour the exhibit hall. Audience members are encouraged to participate in the question and answer segments that follow the presentations.

Service Provider Summit Chair:
Karen Liu, *Vice President, Components and Video Technologies, Ovum, USA*

Service Provider Summit Organizer:
Paul A. Bonenfant, *Communications Components Analyst, Vice President - Equity Research, Morgan Keegan & Co., USA (A note on Paul Bonenfant)*

Schedule-at-a-Glance
Moderators, speakers, and panel descriptions are being confirmed so check this site often for program updates.

See more special programming for service providers.

8:00–8:30 a.m.	Continental Networking Breakfast Sponsored by Juniper Networks
8:30–9:15 a.m.	Keynote Presentation
9:15–10:45 a.m.	Panel I: Evolution to Higher Speed Moderator:David A. Brown, *OIF Market Awareness and Education Committee Co-Chair; Marketing Director, Alcatel-Lucent, USA*
10:45–11:00 a.m.	Coffee Break Sponsored by Juniper Networks
11:00 a.m.–12:30 p.m.	Panel II: What's Going on in Wireless? Moderator:Michael Howard, *Principal Analyst and Co-Founder, Infonetics, USA*
12:30–1:30 p.m.	Networking Lunch Sponsored by Juniper Networks
1:30–5:00 p.m.	Exhibit Time (on your own)

Keynote Presentation

Wednesday, March 9, 2011

8:30–9:15 a.m.

The Financial Industry's Race to Zero Latency and Terabit Networking

Andrew Bach, ***Senior Vice President and Global Head of Network Services, NYSE Euronext, USA***

In the financial industry the pace of business continues to accelerate unabated. This in turn drives the need to reduce transaction times to the lowest possible levels limited only by the availability of the most advanced technology. This talk will outline the compelling business drives that fuel the need for ultra low latency terabit networking.

Andrew F. Bach is Senior Vice President, Global Head of Network Services for NYSE Euronext. In this capacity, he is responsible for planning the company's world wide networks, linking all NYSE, Securities Industries Automation Corporation (SIAC), the American Stock Exchange (AMEX), the Pacific Stock Exchange, Archipelago, LIFFE and European cash markets, as well as the national markets system networks operated by SIAC. In addition to the data networks, Mr. Bach is responsible for the voice and cellular services for the company, including their operations. Currently, Mr. Bach is leading the design and deployment of an ultra high speed, low latency network for two new data centers in the US and EU, which will house all the data processing resources of NYSE Euronext, as well as the co-location of the financial industry's key members. Additionally, Mr. Bach is responsible for all aspects of the technological design and development of the Secure Financial Transaction Infrastructure (SFTI). Under his management, SFTI's technology has expanded from a local New York City metropolitan network to a global network, spanning across several continents and delivering petabytes of data over terabits of bandwidth everyday.

While at SIAC, Mr. Bach has held various positions, including Vice President of Communication Administration, Vice President of Architecture, and Vice President of Project Engineering. Prior to SIAC, Mr. Bach was the manager of software development at EDO Corporation, where he developed advanced sonar signal processing equipment for the world's navies. Mr. Bach sits on the board of the Promise Fund at Polytechnic University in New York City, where he also is an adjunct professor for graduate studies in networking. He also is a member of the Avaya/Nortel Customer Advisory Board, and the Wall Street Technology Association and is an active member of the Institute of Electrical and Electronic Engineers (IEEE) and the Association of Computer Machinery (ACM). Awards for Mr. Bach's contribution to the industry include the prestigious Computer World Smithsonian award in 2000 for his role in the integration of IP multicasting technology in the financial services industry. He also holds multiple patents in communications technologies. Mr. Bach received a Bachelor of Science in Electrical Engineering at the Pratt Institute.

Panel I: Evolution to Higher Speed

Wednesday, March 9, 2011
9:15–10:45 a.m.

Moderator:

David A. Brown, *OIF Market Awareness and Education Committee Co-Chair; Marketing Director, Alcatel-Lucent, USA*

Dave Brown is Market Awareness and Education Committee – Networking Chair and an Officer of the Optical Internetworking Forum (OIF) since 2005.In these roles he manages the OIF marketing strategy and programs focused on accelerating the development and deployment of interoperable optical networks. Current OIF work focuses on multilayer control plane and 100G technologies. At Alcatel-Lucent he is responsible for transport applications marketing in the optics product division. Dave has 29 years of experience in telecommunications marketing including prior roles at Lucent Technologies, AT&T Microelectronics, and a contract manufacturing venture.

Panel Description:

The unabated demand for video and mobile broadband services combined with equally rising user expectations for on-demand, high-quality services propelled the evolution to 100G transport speeds. But this evolution stretched the technical tool set. Going beyond 100G will require new levels of innovation and collaboration—all at a compressed pace versus higher speed evolutions of the past. While everyone agrees that transport speeds beyond 100G will be required, the following questions remain:

- ***What are the market drivers?*** What will be the new killer applications—the next YouTube, the next level of social networking, enterprise service, or the next application for HD or 3-D video?
- ***How will service providers and networks adapt*** in terms of network architectures, flexibility, intelligence, and operational models?
- ***How far beyond 100G must we go—400G, 1T, more…? And by when?***
- ***What new business challenges lay ahead,*** in terms of capitalization and new business case approaches, collaboration, and business models?
- And finally, ***who will be the key players to get us there and how***—telecom service providers, equipment and component vendors, SDOs, content providers, government agencies, etc…?

Speakers:

Getting From Here to There: Market Context
Dana Cooperson, *Vice President, Network Infrastructure, Ovum, USA*

100G is barely deployed, but the industry is on to climbing the next hill. What might lie beyond 100G, and what factors will encourage and inhibit the march

to the summit? This talk will provide a wide view of the market context around evolution to a higher speed.

Dana leads Ovum's Network Infrastructure research advisory and consulting practice, which specializes in fixed broadband access, switching/routing, optical networking, and mobile infrastructure; carrier/vendor financials; and telecom financial deals analysis. Her custom research projects have spanned enterprise use of optical LAN/WAN gear; mobile network traffic management and optimization; mobile network test outsourcing; software product opportunities in ON; green networking and architecture's impact on power consumption; and GPON and Ethernet services opportunity analyses. Dana brought 15 years of telecoms vendor and service provider experience to her 12 years as an industry analyst. Prior to joining RHK/Ovum, Dana was a marketing manager for Tektronix, where she managed telecom test and measurement products. Before Tektronix, she managed multiplexer products at Telco Systems. She began her career in network engineering at NYNEX (now Verizon Communications) in NYC. Dana was awarded an M.S. in Management from MIT and a B.S. in Engineering from Cornell University.

On Speed – Data Over OTN
Hans-Martin Foisel, *Head of Hybrid Technology Department, Deutsche Telekom, Fixed Mobile Engineering, Germany*

A view on high speed networking from carrier perspective will be given, covering not only the technological challenges ahead, but also the key players needed to make >100G a success, in terms of technology, networking, and deployments.

Hans-Martin Foisel joined the Optical Internetworking Forum in 1998. He had served as president from 2007 to 2010, and has been Carrier Working Group Chair since 2002. In these roles he was involved in the developments of multi-domain, multi-layer networking solutions, as well as 100G technologies and systems. At Deutsche Telekom he is Head of Hybrid Network Technology in the Fixed Mobile Engineering Germany department. His main activities comprise intelligent optical networks, optical access networks, and their basic infrastructure elements and systems. He has more than 30 years of experience in optical telecommunication R&D, design, architecture and technology including prior roles at Heinrich-Hertz-Institute in Berlin.

Preparing for the Future
Glenn Wellbrock, *Director of Optical Transport Network Architecture and Design, Verizon, USA*

Given that current generation DWDM systems supported multiple bit rate upgrades, the expectation is that next generation platforms will provide even more scalability. This presentation focuses on key requirements to future proof the transport network.

Glenn Wellbrock is the Director of Optical Transport Network Architecture and Design at Verizon, where he is responsible for the development of new technologies for both the metro and long haul transport infrastructure. Previous positions include running the advanced technology lab, establishing evaluation criteria, and setting engineering guidelines for all backbone transport equipment as well as various positions within network operations. In addition to his 20+ years at Verizon (1984-2001 & 2004-present), Glenn was responsible for Product Architecture within the USA focused optical networks group at Marconi and Product Planning at Qplus Networks with a specific focus on developing alternative modulation techniques.

Panel II: What's Going on in Wireless?

Wednesday, March 9, 2011
11:00 a.m.–12:30 p.m.

Moderator:

Michael Howard, *Principal Analyst and Co-Founder, Infonetics, USA*

Michael Howard co-founded market research firm Infonetics Research in 1990, and today is recognized worldwide as one of telecom's leading experts in emerging markets, service provider trends, and user buying patterns.

Nicknamed the "Ethernet pope," Michael leverages 40 years of communications and market research experience to author numerous works year-round, including market share and forecast reports on carrier Ethernet, routers and switches, IP MPLS VPN, and mobile backhaul. In 2008 he co-authored the book, Carrier Ethernet: Extending Ethernet Beyond the LAN.

An influential thought leader, Michael is a consultant to startups, carriers, vendors, and the investment community; he speaks at industry events year-round; and is frequently quoted in the press, including *Business Week*, *CNN Money*, *The Daily Deal*, *Forbes*, *Fortune*, *Investor's Business Daily*, *NetworkWorld*, *New York Times*, and *The Wall Street Journal*.

Before founding Infonetics, Michael was an IT Director at Tymshare/Tymnet, where he created network accounting and led the First Interstate Bank project that developed the world's first pre-Internet in-home banking system. Prior to that, Michael worked for Systems Development Corporation on operating systems and programming language compilers for ARPAnet, which later became the Internet.

Panel Description:

Wireless/mobile backhaul is a major in-motion market full of promises and problems. Fast growing numbers of mobile broadband subscribers using mobile data cards and smartphones, including iPhones and Androids, have boosted bandwidth and broken many backhaul networks. Operators are furiously upgrading their backhaul networks with Ethernet over copper, fiber, and microwave, a $6.1B equipment market in 2010. Much higher capacities come with HSPA+ and

LTE, which are being deployed now. Many challenges, issues, and new approaches are being trialed, considered, and/or deployed. This panel will cover the following topics:

- The role of fiber at cellsites, aggregation rings, controller sites, and MTSOs
- Mobille BB traffic, early lessons from LTE deployment
- Converged wireless/wireline strategies
- Home/enterprise femtocells, other small cells, and their load on broadband nets

Speakers:

Ethernet: the Next-Gen Distribution Platform for Wireless Backhaul, Brian Hoekelman, Director of Market Development, Time Warner Telecom

Brian has worked in the technology and telecommunications field for nearly 20 years. As Director of Market Development at tw telecom, Brian leads the organization in exploring new services which deliver increased business value to their customers. Prior to tw telecom, Brian held a variety of lead Product and Business Development roles at Qwest, TouchAmerica and ConferTech International (now Polycom). In addition, Brian has consulted in the OSS/BSS field overseeing back-office transformations for a number of large telcos. Brian is a graduate of Oregon State University and holds a Masters in IS from the University of Denver.

Convergence of 2G, 3G, and 4G over a Shared Backhaul Infrastructure, Vijay Lewis, Chief Network Architect, *FiberTower Network Services*

The presentation will be based on FiberTower's experience in providing TDM & Ethernet backhaul solutions to the Wireless Operators in the US. The discussion will examine the backhaul needs of 2G/3G mobile networks, and how the requirements of 4G are changing the way backhaul is done. It will propose ways in which mobile operators can leverage a shared infrastructure to converge their 2G/3G and LTE/WiMax backhaul needs. Finally, the presentation will discuss some of the potential technological, operational, and deployment challenges encountered when moving to an all-packet shared infrastructure, and the lessons learned along the way.

Vijay Lewis has 22+ years of experience in telecommunications and high-speed networking. He currently serves as the Chief Network Architect at FiberTower Corporation, an access and transport provider focused on the backhaul needs of the wireless carrier market. At FiberTower, he is responsible for the specification of its hybrid wireless-fiber network strategy, architecture, engineering standards, equipment selection, vendor management, and advanced product development. Prior to FiberTower, Vijay has served in numerous consulting and leadership roles at startups as well as established carriers like Williams Communications and WorldCom/WilTel. His areas of involvement at these companies have ranged from design support for VoIP and WiFi services to network engineering and integration of legacy Voice, TDM Transport, FR, ATM, and IP networks as well as end-user applications. His areas of expertise include

communications protocols, network architecture/design, equipment qualification, interoperability assurance, traffic engineering, and service implementation. Vijay holds a BS in Electronics Engineering and an MS in Telecommunications.

OFC/NFOEC Press Releases

For your convenience, below is a comprehensive listing of news from OFC/NFOEC 2011. Should you have any questions, please email media@ofcconference.org.

Title	Date
Preparing for the Internet of the Future	Mar 03, 2011
OFC/NFOEC 2011 to Feature Advances in Wireless, Fiber, Multiplexing, Data Center Processing, Cloud Computing, Network Capacity	Mar 01, 2011
Corning Student Paper Competition Finalists Announced	Feb 28, 2011
OFC/NFOEC Exhibit Hall to Feature 500+ Companies Covering Entire Scope of Optical Communications: Datacom, Carrier/Transport/Telecom, Ethernet/IP, 100G, Access/FTTx, Test and Measurement, Green Technology, Wireless and More	Feb 28, 2011
Development Team Achieves One Terabit per Second Data Rate on a Single Integrated Photonic Chip	Feb 24, 2011
OFC/NFOEC 2011 to Feature Business-Focused Programming and 750 Technical Presentations	Feb 23, 2011
OFC/NFOEC Sees Exhibition Hall Growth	Feb 14, 2011
2011 John Tyndall Award Winner Announced	Feb 10, 2011
OFC/NFOEC to Feature Expanded Data Center Programming	Jan 31, 2011
OFC/NFOEC 2011 Announces Plenary Session Speaker Lineup	Sep 29, 2010

Exhibitor News

Many prominent industry corporations unveil innovative new products and research at OFC. Below are announcements from the Conference's exhibiting companies.

OFC exhibiting companies can submit press releases by emailing them to media@ofcconference.org or filling out the online form. Please include any special instructions relating to embargoes or other such restrictions. There is no limit on the number of releases that may be submitted by exhibiting companies.

Please contact Angela Stark, OFC's Communications Director, at 202.416.1443 or via email at media@ofcconference.org with any questions.

Breaking Exhibitor News and Online Press Kits via Business Wire

Company	Title	Date
Photon Kinetics, Inc.	Far Field Scanner Enables Broadband Fiber Characterization	Mar 09, 2011
OE Solutions	OE Solutions Introduces Plastic Optical fiber (POF) Transceiver for Home Networking Applications	Mar 09, 2011
Verizon, EXFO and General Photonics	Verizon, EXFO, and General Photonics Mark First PMD Measurement	Mar 09, 2011
NTT Advanced Technology Corporation	NTT Advanced Technology Introduces New Optical Connector Cleaner, NeoClean EZ	Mar 08, 2011
Aegis Lightwave	Aegis Lightwave Channel Monitors Support Flexible Bandwidth	Mar 08, 2011
Tektronix Component Solutions	Tektronix Component Solutions Introduces Instrument-grade Microwave Modules	Mar 08, 2011
Tektronix Component Solutions	Tektronix Component Solutions Announces 30 GHz Leadless Chip Carrier Packaging Platform	Mar 08, 2011
Opnext, Inc.	Opnext Introduces Next Generation 40G DPSK Line-Side Module	Mar 08, 2011
Opnext, Inc.	Opnext Demonstrates 40GBASE-LR4 QSFP+ Transceiver Module at Industry Leading OFC/NFOEC Conference	Mar 08, 2011

Altera Corporation	Altera Delivers Industry's First Integrated 100G EFEC Solutions for FPGAs	Mar 08, 2011
Opnext, Inc.	Opnext Demonstrates Tunable TOSA at OFC/NFOEC	Mar 08, 2011
Optelian	Optelian Announces 80-Channel High-Bandwidth Optical Networking Platform	Mar 08, 2011
OE Solutions	OE Solutions Announces Successful Demonstration of 10GbE Single Wavelength Bi-Directional (SWBiDi) XFP	Mar 08, 2011
Semtech Corporation	Semtech Ships First 100G CFP MSA-Compliant Gearbox IC Platform for 100G Optical Networks	Mar 08, 2011
Avago Technologies	Avago Technologies Unveils Market's First Optical Transceiver Platform with 14-Gbps per Lane Performance	Mar 08, 2011
Avago Technologies	Avago Announces the World's Most Comprehensive Fiber Optic Portfolio for Data Center, Storage, Computing and Consumer Applications	Mar 08, 2011
Glimmerglass Networks	Glimmerglass Networks Speaks on Intelligent Optical Signal Management and Network Performance Monitoring at OFC/NFOEC 2011	Mar 08, 2011
Gennum Corporation	Gennum Enables 100Gb/s Networks with 25Gb/s Reference-Free Clock and Data Recovery ICs	Mar 08, 2011
Analog Devices Inc.	Industry's First 11-Gbps and 6-Gbps Integrated Optical Receivers Unveiled At OFC 2011	Mar 08, 2011
Aegis Lightwave	Aegis Lightwave Introduces Ultra-Compact Channel Monitor	Mar 07, 2011
OE Solutions	OE Solutions Announces Industry's First Industrial Temperature CWDM/DWDM XFP Transceiver for Metro WDM Networks in Uncontrolled Environments	Mar 07, 2011
Nokia Siemens Networks US	Nokia Siemens Networks Delivers Smart Transport	Mar 07, 2011

LLC (NSN)	at OFC/NFOEC	
Nokia Siemens Networks US LLC (NSN)	UTS Users Enjoy High-speed Data Services	Mar 07, 2011
EXFO	EXFO Adds Detailed EVM and BER Analysis, Mask Tests and Support of Homodyne Characterization to Its PSO-200 Optical Modulation Analyzer	Mar 07, 2011
Opnext, Inc.	Opnext High Speed Technology Leadership Highlighted	Mar 07, 2011
Opnext, Inc.	Opnext Announces Production Release of 40GBASE-LR4 CFP Transceiver	Mar 07, 2011
Semtech Corporation	Semtech 40G MUX/DEMUX Platform Enables JDSU 40G Metro Optical Network Transponder Solutions	Mar 07, 2011
Optelian	Optelian Expands Product Portfolio; Announces Availability of Tunable XFPs	Mar 07, 2011
Broadcom Corporation	Broadcom Announces Industry's First Quad 10GbE SFP+ PHY with MACsec	Mar 07, 2011
Avago Technologies	Avago Technologies and Xilinx Streamline Design of 10 Gigabit Ethernet Systems Using FPGAs and Optical Interconnects	Mar 07, 2011
VPIsystems	VPItransmissionMaker™ / VPIcomponentMaker™ Version 8.6 - Dramatic Speedup Through Multithreading and GPU-assisted Simulations	Mar 07, 2011
Broadcom Corporation	Broadcom Announces Industry's Lowest Power Dual/Quad CDRs for High Density 10G Applications	Mar 07, 2011
NeoPhotonics Corporation	NeoPhotonics® Photonic Integrated Circuit (PIC) Products Surpass 3 Billion Operating Hours Without A Reported Field Failure	Mar 07, 2011
AppliedMicro	AppliedMicro Ships 1 Million 10G OTN Ports	Mar 07, 2011
Auxora, Inc.	Auxora Introduces 50GHz Tunable Filter Chip	Mar 07, 2011

Sumitomo Electric Device Innovations U.S.A., Inc	Sumitomo Electric and Ixia to Demonstrate 40 GbE CFP Transceiver for Distances up to 40 km at OFC 2011	Mar 07, 2011
Sumitomo Electric Device Innovations U.S.A., Inc	Sumitomo Electric to Showcase 25 Gb/s EML TOSA and PIN ROSA for 100G Base-LR4 at OFC 2011	Mar 07, 2011
Optical Internetworking Forum	The OIF Looks Beyond 100G at OFC/NFOEC	Mar 04, 2011
Infinera	Infinera to Present on Next-Generation PICs and Systems at OFC	Mar 04, 2011
Infinera	Infinera Presents on First-Ever Terabit PIC at OFC	Mar 04, 2011
EXFO	EXFO Extends Its Optical Transport Network (OTN) Testing Capabilities to Qualify 100G/40G Ethernet Client Services	Mar 04, 2011
Nokia Siemens Networks US LLC (NSN)	Nokia Siemens Networks and Juniper Networks Conduct 100G Interoperability Trial	Mar 04, 2011
JDSU	JDSU to Highlight Key Technology at OFC/NFOEC 2011	Mar 04, 2011
VPIsystems	VPIcomponentMaker Photonics Circuits – New Design Tool for Large-scale Photonic Integrated Circuits	Mar 04, 2011
Oclaro, Inc.	Oclaro Showcases High-Speed Optical Networking Leadership During OFC/NFOEC 2011; Executives Presenting on Three Panels	Mar 04, 2011
NeoPhotonics Corporation	NeoPhotonics Chairman to Join Optical Components Panel	Mar 04, 2011
Kaiam Corp.	Kaiam Demonstrates 40gb/S Transmitter and Receiver Optical Subassemblies For Lr4 Applications at OFC/NFOEC 2011	Mar 03, 2011
EXFO	EXFO and Opnext to Demo 100GBASE-LR4 CFP Optic Testing at OFC/NFOEC 2011	Mar 03, 2011
Molex	Molex QSFP+ Active Optical Cable (AOC) Assemblies Provide Unmatched Reach at a Fraction	Mar 03, 2011

	of the Power	
Enablence, Inc.	Enablence Unveils Pic-based Integrated Multicast Switch	Mar 03, 2011
IP Light	Apodis OTN Processors and Framers	Mar 03, 2011
Fibercore Limited	Fibercore to Demonstrate Bow-Tie Fiber Splicing Made Easy at OFC/NFOEC 2011	Mar 03, 2011
Proximion Fiber Systems AB	Proximion Doubles Production Capacity to Meet Record Demand	Mar 03, 2011
TeraXion, Inc.	TeraXion Introduces Coherent Communication Products Portfolio	Mar 02, 2011
Avago Technologies	Avago Technologies mini-SFP+ Optical Transceivers Increase Port Density for Storage and Ethernet Equipment	Mar 02, 2011
Fibotec Fiberoptics GmbH	Monitoring Band PON-OTDR	Mar 02, 2011
Gould Technology, LLC	Gould Fiber Optics Celebrates Its 25th Anniversary as a Leader in Manufacturing and Supplying Fiber Optic Components and Integrated Assembly Solutions	Mar 02, 2011
3S PHOTONICS/Avensys/ITF Labs	3S PHOTONICS, Avensys Tech and ITF Labs will attend OFC/NFOEC 2011	Mar 01, 2011
CIENA Corporation	Ciena WaveLogic Coherent Optical Processors Power Next Phase of High Capacity	Mar 01, 2011
Altera Corporation	Altera Demonstrates Industry-Leading OTN Technology Solutions at OFC/NFOEC 2011	Mar 01, 2011
EXFO	Strong EXFO Contribution to the Technical Program at OFC/NFOEC 2011	Mar 01, 2011
3M Communication Markets Division	Optelian Partners with Bharat Electronics Ltd. of India	Feb 14, 2011
Enablence, Inc.	Enablence Leads RFOG Session At OFC/NFOEC 2011	Feb 14, 2011

VPIsystems	MRV Deploys VPILinkConfigurator for Optical Network Design	Feb 14, 2011
IPtronics	IPtronics Releases New 4ch Chip Set	Feb 10, 2011
Telescent Inc	Telescent Inc. Awarded a U.S. Department of Energy SBIR Phase II Research Grant	Feb 08, 2011
Gould Technology, LLC	Gould Fiber Optics: Recipient of U.S. Navy's Life of Type Buy Award to Supply Optical Fiber Splitters in Support of Modernization of the Trident Missile Guidance System	Feb 03, 2011
Light Brigade, Inc., The	Light Brigade to Host CFHP Course at 2011 Optical Fiber Communication Conference	Jan 19, 2011
Telescent Inc	Telescent Awarded a U.S. Department of Energy Research Grant to Develop Massively Scalable Automated Patch-Panels for “Lights-out” Data Centers and Communication Networks	Jan 05, 2011
IPtronics	IPtronics Offers New Low Cost Silicon	Jan 05, 2011
Hittite Microwave Corporation	Three New MMIC Phase Shifters Span 1.2 to 8 GHz	Dec 21, 2010
Hittite Microwave Corporation	Four New SMT Passive Attenuator Pads for DC to 25 GHz Applications	Dec 21, 2010
Seikoh Giken Co., Ltd.	Seikoh Giken Company Introduces FerrulePro™ – The World’s First Benchtop Fiber Cleaner	Dec 07, 2010
Analog Modules, Inc.	OEM Seed Laser Diode Driver Assembly	Aug 19, 2010

Short Courses

General Information

Short Courses cover a broad range of topic areas at a variety of educational levels. The courses are taught by highly regarded industry experts on subjects such as 40 Gb/s transmission systems,

optical transmission systems, photonic integrated circuits, and ROADM technologies. New topics for 2011 include computercom interconnects and data center networking.

Short Courses are an excellent opportunity to learn about new products, cutting-edge technology and vital information at the forefront of communications. Whether you choose a course designed for beginners or for more advanced instruction, the small size of each class gives you an excellent opportunity for personalized instruction. Short Courses are also an opportunity to earn Continuing Education Units (CEUs) and to meet one of the key requirements to maintaining your PE license.

Continuing Education Units (CEUs)

The CEU is a nationally recognized unit of measure used to quantify continuing education and training activities. Continuing Education Units (CEUs) were created as a way to document noncredit work in specifically developed activities for adult learners in a variety of disciplines. One CEU is defined as "10 contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction."

Registration

Register for a Short Course and you also receive free admission to:

- OFC/NFOEC Exhibition
- Plenary Session
- Workshops
- Market Watch
- Service Provider Summit
- Exhibit Floor Activities

Registration will open in late September 2010.

Free Short Course Offer for Student Members

After the pre-registration deadline (February 14, 2011), student members of sponsoring organizations may register for free for select Short Courses not yet at capacity. Many Short Courses are in high demand—the best way to ensure admittance is to pre-register for the course before it reaches capacity. On-site registration is not guaranteed. Free student registration will not be available for hands-on courses, full-day courses, or courses that are filled before the pre-registration deadline.

To achieve the full value of attending a Short Course, students who take advantage of the free course offer are strongly encouraged to pre-purchase Short Course Notes for $15 at the time that

they register for the course. Short Course Notes are a valuable take-home benefit of attending a course, and these notes will be available only to attendees of the course. (Paid attendees receive one copy of the notes.

Register early to guarantee a space in a Short Course!

Visit the registration page after February 14 to sign up for a free Short Course and purchase the corresponding course notes. (If you are already registered for OFC/NFOEC, you will need to update your registration to select from the available Short Courses.)

Short Courses by Topic

Category 1. Optical Network Applications and Services
Category 2. Network Technologies and Applications
Category 3. FTTx Technologies, Deployment, and Applications
Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors
Category 7. Optical Devices for Switching, Filtering and Signal Compensation
Category 8. Optoelectronic Devices
Category 9. Digital Transmission Systems
Category 10. Transmission Subsystems and Network Elements
Category 11. Optical Processing and Analog Subsystems
Category 12. Core Networks
Category 13. Access Networks
Category 14. Datacom, Computercom, and Short Range and Experimental Optical Networks
Additional Short Course Category: Industry Best Practices

Category 1. Optical Network Applications and Services

SC102 WDM in Long-Haul Transmission Systems,
Neal S. Bergano; Tyco Telecommunications, USA

SC171 Introduction to Optical Control Plane Concepts, Technologies and Practices,
Greg Bernstein; Grotto Networking, USA

SC176 Metro Network: The Transition to Ethernet,
Loudon Blair; Ciena Corp., USA

SC203 40/100 Gb/s Transmission Systems, Design and Design Trade-offs,
Martin Birk[1], Benny Mikkelsen[2]; [1]AT&T Labs–Res., USA, [2]Acacia Communications, USA

SC216 An Introduction to Optical Network Design and Planning,
Jane M. Simmons; Monarch Network Architects, USA

SC243 Next Generation Transport Networks: The Evolution from Circuits to Packets,
Ori A. Gerstel; Cisco Systems, USA

SC261 ROADM Technologies and Network Applications,
Thomas Strasser; Nistica Inc., USA

SC264 Introduction to Ethernet Technologies,
Jeffrey Cox; BT, USA

SC289 Basics of Optical Communication Systems and WDM,
Gerd Keiser[1,2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan

SC327 Modeling and Design of Fiber-Optic Communication Systems,
Rene-Jean Essiambre; Bell Labs, Alcatel-Lucent, USA

SC328 New Developments in Optical Transport Networking (OTN),
Stephen Trowbridge; Alcatel-Lucent, USA

New Course! SC356 40G/100G Ethernet Technologies and Applications,
Osamu Ishida; NTT, Japan

Category 2. Network Technologies and Applications

SC101 Hands-on Workshop on Fiber Optic Measurements and Component Testing,
Caroline Connolly[1], Chris Heisler[1], Richard Buerli[1], Joseph Bos[2], Michelle Collier[3], [1]OptoTest Corp., USA, [2]Luna Technologies, USA, [3]AFL Telecommunications, USA

SC178 Test and Measurement of High-Speed Communications Signals,
Greg LeCheminant; Agilent Technologies, USA

SC185 Hands-on Polishing, Inspection and Testing of Connectors,
Cameron Karch[1], Steve Baldo[2], Neal Wagman[3]; [1]Light Brigade Inc., USA, [2]Seikoh Giken Co. Ltd., USA, [3]Norland Products, USA

Cancelled SC186 Hands-on Specialty Fiber Splicing,
Clyde J. Troutman; 3SAE Technologies, USA

SC187 Hands-on Basic Fiber Optics for the Absolute Beginners,
Dennis Horwitz; Micronor Inc., USA

SC203 40/100 Gb/s Transmission Systems, Design and Design Trade-offs,
Martin Birk[1], Benny Mikkelsen[2]; [1]AT&T Labs–Res., USA, [2]Acacia Communications, USA

SC210 Hands-on Polarization-Related Measurements Workshop,
Daniel Peterson[1], Tasshi Dennis[2], Brian Teipen[3], Christine Tremblay[4]; [1]Verizon Business, USA, [2]NIST, USA, [3]ADVA Optical Networking, Germany, [4]École de Technologie Supérieure, Univ. du Québec, Canada

SC264 Introduction to Ethernet Technologies,
Jeffrey Cox; BT, USA

SC266 Quantum Cryptography and Quantum Information,
Richard Hughes[1], Thomas Chapuran[2]; [1]Los Alamos Natl. Lab, USA, [2]Telcordia, USA

SC289 Basics of Optical Communication Systems and WDM,
Gerd Keiser[1,2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan

SC291 Hands-on Fiber Optics for Engineers Designing for Military, Aerospace, Shipboard and Industrial Harsh Environmental Applications,
Dennis Horwitz; Micronor Inc., USA

SC314 Hands-on Fiber Characterization for the Engineering of Long Haul and Metro Deployments,
Daniel Peterson[1], Christine Tremblay[2]; [1]Verizon, USA, [1]École de Technologie Supérieure, Univ. du Québec, Canada

SC347 Reliability and Qualification of Fiber-Optic Components,
David Maack; Corning, USA

New Course! SC360 Hands-On Fiber Optic Terminations and Measurements with Emphasis on MTP Connectorized Ribbon Fiber,
Caroline Connolly[1], Christopher Heisler[1], Richard Buerli[1], Loïc Cherel[2], Tony Nicholson[3], Mike Hughes[4], Brian Teague[4]; [1]OptoTest Corp., USA, [2]Data-Pixel SAS, France, [3]Connected Fibers, USA, [4]Conec Ltd., USA

Category 3. FTTx Technologies, Deployment, and Applications

SC101 Hands-on Workshop on Fiber Optic Measurements and Component Testing,
Caroline Connolly[1], Chris Heisler[1], Richard Buerli[1], Joseph Bos[2], Michelle Collier[3], [1]OptoTest Corp., USA, [2]Luna Technologies, USA, [3]AFL Telecommunications, USA

SC114 Passive Optical Networks (PONs),
Frank J. Effenberger; Huawei Technologies, USA

SC185 Hands-on Polishing, Inspection and Testing of Connectors,
Cameron Karch[1], Steve Baldo[2], Neal Wagman[3]; [1]Light Brigade Inc., USA, [2]Seikoh Giken Co. Ltd., USA, [3]Norland Products, USA

Cancelled SC186 Hands-on Specialty Fiber Splicing,
Clyde J. Troutman; 3SAE Technologies, USA

SC187 Hands-on Basic Fiber Optics for the Absolute Beginners,
Dennis Horwitz; Micronor Inc., USA

SC264 Introduction to Ethernet Technologies,
Jeffrey Cox; BT, USA

SC267 Silicon Microphotonics: Technology Elements and the Roadmap to Implementation,
Lionel Kimerling; MIT, USA

SC347 Reliability and Qualification of Fiber-Optic Components,
David Maack; Corning, USA

Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors

SC208 Optical Fiber Design for Telecommunications and Specialty Applications,
David J. DiGiovanni; OFS Labs, USA

SC267 Silicon Microphotonics: Technology Elements and the Roadmap to Implementation,
Lionel Kimerling; MIT, USA

Category 7. Optical Devices for Switching, Filtering, and Signal Compensation

SC265 Passive Optical Components and Filtering Technologies,
Bruce Nyman[1], Christi Madsen[2]; [1]Tyco Electronics SubCom, USA, [2]Texas A&M Univ., USA

Category 8. Optoelectronic Devices

SC175 Packaging of Optoelectronic, Photonic and MEMS Components,
Tolga Tekin1,[2]; [1]Technische Univ. Berlin, Germany, [2]Fraunhofer-Inst. für Zuverlaessigkeit und Mikrointegration (IZM) System Integration and Interconnection Technologies, Germany

SC177 High-Speed Semiconductor Lasers and Modulators,
John Bowers; Univ. of California at Santa Barbara, USA

SC178 Test and Measurement of High-Speed Communications Signals,
Greg LeCheminant; Agilent Technologies, USA

SC182 Biomedical Optical Diagnostics and Sensing,
Thomas Huser; Univ. of California at Davis, USA

SC325 Highly Integrated Monolithic Photonic Integrated Circuits,
Chris Doerr; Bell Labs, Alcatel-Lucent, USA

Category 9. Digital Transmission Systems

SC102 WDM in Long-Haul Transmission Systems,
Neal S. Bergano; Tyco Telecommunications, USA

SC203 40/100 Gb/s Transmission Systems, Design and Design Trade-offs,
Martin Birk[1], Benny Mikkelsen[2]; [1]AT&T Labs–Res., USA, [2]Acacia Communications, USA

SC205 Integrated Electronic Circuits and Signal Processing for Fiber Optics,
Y. K. Chen, Noriaki Kaneda; Bell Labs, Alcatel Lucent, USA

SC259 Electronic and Optical Impairment Mitigation,
Chris Fludger[1], Seb Savory[2]; [1]CoreOptics GmbH, Germany, [2]Univ. College London, UK

SC289 Basics of Optical Communication Systems and WDM,
Gerd Keiser[1,2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan

SC314 Hands-on Fiber Characterization for the Engineering of Long Haul and Metro Deployments,
Daniel Peterson[1], Christine Tremblay[2]; [1]Verizon, USA, [1]École de Technologie Supérieure, Univ. du Québec, Canada

SC327 Modeling and Design of Fiber-Optic Communication Systems,
Rene-Jean Essiambre; Bell Labs, Alcatel-Lucent, USA

SC342 Digital Coherent Optical Communications,
Maurice O'Sullivan; Ciena, Canada

Category 10. Transmission Subsystems and Network Elements

SC101 Hands-on Workshop on Fiber Optic Measurements and Component Testing,
Caroline Connolly[1], Chris Heisler[1], Richard Buerli[1], Joseph Bos[2], Michelle Collier[3], [1]OptoTest Corp., USA, [2]Luna Technologies, USA, [3]AFL Telecommunications, USA

SC105 Modulation Formats and Receiver Concepts for Optical Transmission Systems,
Peter Winzer, Chandrasekhar Sethumadhavan; Bell Labs, Alcatel-Lucent, USA

SC141 Combating and Monitoring Data-Degrading Effects in Non-Static WDM Systems,
Alan Willner; Univ. of Southern California, USA

SC178 Test and Measurement of High-Speed Communications Signals,
Greg LeCheminant; Agilent Technologies, USA

SC239 Short-Reach Optical Interconnects,
Steve Joiner; Finisar, USA

SC289 Basics of Optical Communication Systems and WDM,
Gerd Keiser[1,2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan

SC341 OFDM for Optical Communications,
Sander L. Jansen; Nokia Siemens Networks, Germany

New Course! SC360 Hands-On Fiber Optic Terminations and Measurements with Emphasis on MTP Connectorized Ribbon Fiber,
Caroline Connolly[1], Christopher Heisler[1], Richard Buerli[1], Loïc Cherel[2], Tony Nicholson[3], Mike Hughes[4], Brian Teague[4]; [1]OptoTest Corp., USA, [2]Data-Pixel SAS, France, [3]Connected Fibers, USA, [4]Conec Ltd., USA

Category 11. Optical Processing and Analog Subsystems

SC160 Microwave Photonics,
Keith Williams; NRL, USA

SC217 Hybrid Fiber Radio: The Application of Photonic Links in Wireless Communications,
Dalma Novak; Pharad, USA

Category 12. Core Networks

SC171 Introduction to Optical Control Plane Concepts, Technologies and Practices,
Greg Bernstein; Grotto Networking, USA

SC176 Metro Network: The Transition to Ethernet,
Loudon Blair; Ciena Corp., USA

SC216 An Introduction to Optical Network Design and Planning,
Jane M. Simmons; Monarch Network Architects, USA

SC243 Next Generation Transport Networks: The Evolution from Circuits to Packets,
Ori A. Gerstel; Cisco Systems, USA

SC261 ROADM Technologies and Network Applications,
Thomas Strasser; Nistica Inc., USA

SC264 Introduction to Ethernet Technologies,
Jeffrey Cox; BT, USA

SC289 Basics of Optical Communication Systems and WDM,
Gerd Keiser[1,2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan

SC327 Modeling and Design of Fiber-Optic Communication Systems,
Rene-Jean Essiambre; Bell Labs, Alcatel-Lucent, USA

SC328 New Developments in Optical Transport Networking (OTN),
Stephen Trowbridge; Alcatel-Lucent, USA

New Course! SC356 40G/100G Ethernet Technologies and Applications,
Osamu Ishida; NTT, Japan

Category 13. Access Networks

SC114 Passive Optical Networks (PONs),
Frank J. Effenberger; Huawei Technologies, USA

SC217 Hybrid Fiber Radio: The Application of Photonic Links in Wireless Communications,
Dalma Novak; Pharad, USA

SC264 Introduction to Ethernet Technologies,
Jeffrey Cox; BT, USA

SC267 Silicon Microphotonics: Technology Elements and the Roadmap to Implementation,
Lionel Kimerling; MIT, USA

Category 14. Datacom, Computercom, and Short Range and Experimental Optical Networks

SC187 Hands-on Basic Fiber Optics for the Absolute Beginners,
Dennis Horwitz; Micronor Inc., USA

SC267 Silicon Microphotonics: Technology Elements and the Roadmap to Implementation,
Lionel Kimerling; MIT, USA

SC291 Hands-on Fiber Optics for Engineers Designing for Military, Aerospace, Shipboard and Industrial Harsh Environmental Applications,
Dennis Horwitz; Micronor Inc., USA

SC314 Hands-on Fiber Characterization for the Engineering of Long Haul and Metro Deployments,
Daniel Peterson[1], Christine Tremblay[2]; [1]Verizon, USA, [1]École de Technologie Supérieure, Univ. du Québec, Canada

New Course! SC356 40G/100G Ethernet Technologies and Applications,
Osamu Ishida; NTT, Japan

New Course! SC357 Computercom Interconnects: Circuits and Equalization Methods for Short Reach Power and Cost-Optimized Optical and Electrical Links,
Alexander Rylyakov; IBM T.J. Watson Res. Ctr., USA

New Course! SC358 Data Center Cabling—Transitioning from Copper to Fiber,
Lisa A. Huff[1,2]; [1]DataCenterStocks.com, USA, [2]Discerning Analytics, LLC, USA

New Course! SC359 Datacenter Networking 101,
Cedric Lam, Hong Liu; Google, USA

Additional Short Course Category: Industry Best Practices

SC347 Reliability and Qualification of Fiber-Optic Components,
David Maack; Corning, USA

Short Courses by Time

Sunday, March 6

Time	Code	Title
9:00 AM - 12:00 PM	**SC171**	**Introduction to Optical Control Plane Concepts, Technologies and Practices**
9:00 AM - 12:00 PM	**SC356**	**New Course! 40G/100G Ethernet Technologies and Applications**
9:00 AM - 12:00 PM	**SC325**	**Highly Integrated Monolithic Photonic Integrated Circuits**
9:00 AM - 12:00 PM	**SC105**	**Modulation Formats and Receiver Concepts for Optical Transmission Systems**
9:00 AM - 12:00 PM	**SC341**	**OFDM for Optical Communications**
9:00 AM - 12:00 PM	**SC114**	**Passive Optical Networks (PONs)**
9:00 AM - 1:00 PM	**SC239**	**Short-Reach Optical Interconnects**
9:00 AM - 1:00 PM	**SC288**	**Fundamentals of Polarization, PMD and PDL in Lightwave Systems**
1:00 PM - 4:00 PM	**SC216**	**An Introduction to Optical Network Design and Planning**
1:00 PM - 4:00 PM	**SC203**	**40/100 Gb/s Transmission Systems, Design and Design Trade-offs**

1:00 PM - 4:00 PM	**SC267**	**Silicon Microphotonics: Technology Elements and the Roadmap to Implementation**
1:00 PM - 4:00 PM	**SC328**	**New Developments in Optical Transport Networking (OTN)**
1:00 PM - 4:00 PM	**SC357**	**New Course! Computercom Interconnects: Circuits and Equalization Methods for Short Reach Power and Cost-Optimized Optical and Electrical Links**
1:00 PM - 4:00 PM	**SC177**	**High-Speed Semiconductor Lasers and Modulators**
4:30 PM - 7:30 PM	**SC259**	**Electronic and Optical Impairment Mitigation**
4:30 PM - 7:30 PM	**SC327**	**Modeling and Design of Fiber-Optic Communication Systems**
4:30 PM - 7:30 PM	**SC243**	**Next Generation Transport Networks: The Evolution from Circuits to Packets**
4:30 PM - 7:30 PM	**SC217**	**Hybrid Fiber Radio: The Application of Photonic Links in Wireless Communications**
4:30 PM - 7:30 PM	**SC265**	**Passive Optical Components and Filtering Technologies**

Monday, March 7

Time	Code	Title
8:30 AM - 12:30 PM	**SC178**	**Test and Measurement of High-Speed Communications Signals**
8:30 AM - 12:30 PM	**SC102**	**WDM in Long-Haul Transmission Systems**
8:30 AM - 12:30 PM	**SC342**	**Digital Coherent Optical Communications**
8:30 AM - 12:30 PM	**SC101**	**Hands-on Workshop on Fiber Optic Measurements and Component Testing**
8:30 AM - 12:30 PM	**SC160**	**Microwave Photonics**

8:30 AM - 4:00 PM	**SC264**	**Introduction to Ethernet Technologies**
9:00 AM - 12:00 PM	**SC208**	**Optical Fiber Design for Telecommunications and Specialty Applications**
9:00 AM - 12:00 PM	**SC261**	**ROADM Technologies and Network Applications**
9:00 AM - 12:00 PM	**SC141**	**Combating and Monitoring Data-Degrading Effects in Non-Static WDM Systems**
9:00 AM - 12:00 PM	**SC358**	**New Course! Data Center Cabling—Transitioning from Copper to Fiber**
1:00 PM - 5:30 PM	**SC187**	**Hands-on Basic Fiber Optics for the Absolute Beginners**
1:30 PM - 4:30 PM	**SC175**	**Packaging of Optoelectronic, Photonic and MEMS Components**
1:30 PM - 4:30 PM	**SC205**	**Integrated Electronic Circuits and Signal Processing for Fiber Optics**
1:30 PM - 4:30 PM	**SC266**	**Quantum Cryptography and Quantum Information**
1:30 PM - 4:30 PM	**SC289**	**Basics of Optical Communication Systems and WDM**
1:30 PM - 4:30 PM	**SC176**	**Metro Network: The Transition to Ethernet**
1:30 PM - 5:30 PM	**SC185**	**Hands-on Polishing, Inspection and Testing of Connectors**
1:30 PM - 5:30 PM	**SC210**	**Hands-on Polarization-Related Measurements Workshop**
1:30 PM - 5:30 PM	**SC360**	**New Course! Hands-On Fiber Optic Terminations and Measurements with Emphasis on MTP Connectorized Ribbon Fiber**
1:30 PM - 5:30 PM	**SC186**	**Cancelled Hands-on Specialty Fiber Splicing**

Tuesday, March 8

Time	Code	Title
8:00 AM - 12:30 PM	**SC291**	**Hands-on Fiber Optics for Engineers Designing for Military, Aerospace, Shipboard and Industrial Harsh Environmental Applications**
9:00 AM - 12:00 PM	**SC359**	**New Course! Datacenter Networking 101**
2:00 PM - 6:00 PM	**SC347**	**Reliability and Qualification of Fiber-Optic Components**
2:00 PM - 6:00 PM	**SC182**	**Biomedical Optical Diagnostics and Sensing**
2:00 PM - 6:00 PM	**SC314**	**Hands-on Fiber Characterization for the Engineering of Long Haul and Metro Deployments**

Short Course Descriptions

SC171 Introduction to Optical Control Plane Concepts, Technologies and Practices

Sunday, March 6, 2011
9:00 AM - 12:00 PM

Instructor: *Greg Bernstein; Grotto Networking, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course introduces optical control plane concepts, technologies, and practices. Three key factors have pushed the deployment of control plane technologies into optical transport networks. First, optical transport networks have grown in capacity (DWDM) and number of elements deployed. Second, to remain competitive carriers need to dynamically allocate expensive or limited optical resources to their customers in a timely manner. Third, element management systems from different equipment vendors tend not to interoperate. These factors and others have led to the emergence of the optical control plane and its deployment in carrier's network as a key supplement to existing management systems.

Key concepts in the optical control plane to be covered include: neighbor discovery, link verification, rapid provisioning, dissemination of reachability information, dissemination of topology and resource status information, and path computation.

We will review the key standards for the optical control plane from the IETF, ITU, and the OIF. Included in this course are the latest emerging standards on wavelength switched optical networks (WSONs) being developed at the IETF. Examples from both TDM-based optical networks and transparent optical networks consisting of ROADMs will be given. Deployment options and additional restoration (beyond linear and ring) functionality will also be discussed.

Benefits:

This course should enable you to:

- Compare and contrast the use of these new control plane based standards with Element Management System (EMS) based approaches.
- List the key organizations involved in determining optical control plane standards or agreements and their relationships.
- Describe the differences and similarities in the control of TDM and transparent optical networks.
- Describe the protocols used in the optical control plane in terms of their heritage and functionality.
- Describe the purpose of neighbor discovery.
- Explain the use of link state route protocols as applied to optical networks.
- Discuss the differences between datagram and optical routing with regard to service impact and standardization.
- Summarize and justify the functionality provided by the basic components of the optical control plane.

Audience:

This course is an introductory course on optical control plane standards. As such it assumes familiarity with SDH/SONET and WDM technology. Its emphasis will be on explaining the various control plane protocols to those with minimal prior experience in the areas of signaling or routing.

Instructor Biography:

Dr. Bernstein is currently Chief Consultant at Grotto Networking and is active in network standardization, network design, network equipment design, and network research for a variety of customers. He has been involved with standards development at the IETF, OIF, ITU-T, and ANSI Committee T1. Previously he was a Senior Director at Ciena Corp. after directing all software development at Lightera Networks (acquired by Ciena) where his team applied signaling and routing techniques to the control of networks of Lightera optical switches (now the Ciena CoreDirector). He is the lead author of the book Optical Network Control: Architecture,

Protocols, and Standards, published by Addision-Wesley in 2004, and has written many articles and papers on the control of optical networks. He received his Ph.D., M.S. and B.S. degrees in electrical engineering and computer science from the University of California at Berkeley.

SC356 40G/100G Ethernet Technologies and Applications

New Course!

Sunday, March 6, 2011
9:00 AM - 12:00 PM

Instructor: *Osamu Ishida; NTT, Japan*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This short course provides an overview of the challenges, current solutions, and future trends in the highest-speed Ethernet technologies and applications.

The paradigm of optical interface has shifted at 40Gb/s both in technology and in application, from serial to multi-lane and from WAN-driven to SAN-driven, respectively. The course first reviews historical trends, Ethernet evolution in its speed and applications, and Ethernet penetrations into WAN and SAN. Then the 40Gb/s and 100Gb/s Ethernet (IEEE802.3ba) physical layer architecture, technologies, and implementations with pluggable modules are discussed in detail for providing an insight into current and future technology trends. Finally the course highlights the emerging 40G/100G Ethernet use cases both in telecom and datacom applications, such as aggregated transport in optical transport network (OTN) and converged network interface for fiber channel over Ethernet (FCoE) in cloud data center.

Benefits:

This course should enable you to:

- Overview historical Ethernet evolution in its speeds and applications.
- Identify key concepts behind the Ethernet physical layer technologies.
- Describe 40G/100G Ethernet physical layer architecture and interfaces.
- Appreciate the 10G technologies leveraged with the lane distribution mechanism.
- Discuss the various form-factors of 40G/100G pluggable transceiver modules.
- Gain an insight into future trends regarding higher-speed Ethernet.
- Compare technology options for wide- and storage-area-network applications.
- Explain 40G/100G Ethernet accommodation into optical transport network (OTN).
- Discuss data center Ethernet converged with fiber channel applications.

Audience:

This course is intended for engineers, researchers, and technical managers who would like to gain a better understanding of newly standardized IEEE802.3ba 40G/100G Ethernet technologies and use cases both in telecom and datacom applications. No prior knowledge of Ethernet is required.

Instructor Biography:

Osamu Ishida is a Senior Research Engineer/Supervisor at NTT and leads the Photonic Networking Systems Research group at NTT Network Innovation Labs, Yokosuka, Japan. He has over 20 years of experience at NTT Labs in research on high-speed Ethernet transport, WDM cross-connect, and coherent optical fiber communications. He has been involved with standards development of 10G/40G/100G Ethernet (IEEE 802.3) and the revision of OTN (ITU-T G.709). Recently he has served as a guest editor for IEEE COM-M. He is the author or co-author of more than 50 journal and conference articles in English and a co-editor of the textbook 10 Gb/s Ethernet Technologies published by Impress Japan in 2005. He received his M.E. and B.E. degrees in electrical engineering from the University of Tokyo, Japan.

SC325 Highly Integrated Monolithic Photonic Integrated Circuits

Sunday, March 6, 2011
9:00 AM - 12:00 PM

Instructor: *Chris Doerr; Bell Labs, Alcatel-Lucent, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

This course will discuss photonic integrated circuits (PICs) in InP, silicon, and related materials for optical communications. The course will start with optical waveguide fundamentals and move toward complicated state-of-the-art devices with many elements monolithically integrated. Higher layers of PIC design will be stressed.

Benefits:

This course should enable you to:

- Design optical waveguide structures.
- Simulate optical waveguide structures.
- Design complex photonic integrated circuits.
- Simulate photonic integrated circuits.

- Understand some of the device physics.
- Design electronics for driving photonic integrated circuits.
- Predict future abilities and costs of photonic integrated circuits.
- Debug problems in photonic integrated circuits.

Audience:

This course is intended for anyone who has basic electro-magnetics knowledge (e.g., know that Maxwell's equations exist, but do not have to have them memorized) and basic optical communications knowledge (e.g., know what optical fiber is but do not have to know what 16-QAM is), but wants to learn more about photonic integrated circuits.

Instructor Biography:

Christopher R. Doerr earned a bachelor's degree in aeronautical/astronautical engineering and bachelor's, master's, and doctorate degrees in electrical engineering, all from MIT. He attended MIT on an Air Force ROTC scholarship. His doctoral thesis, on constructing a fiber-optic gyroscope with noise below the quantum limit, was supervised by Prof. Hermann Haus. Since coming to Bell Labs in 1995, Doerr's research has focused on integrated devices for optical communication. He was promoted to Distinguished Member of Technical Staff in 2000 and received the OSA Engineering Excellence Award in 2002. Doerr was Editor-in-Chief of IEEE Photonics Technology Letters, and was an elected member of the LEOS Board of Governors. He became an IEEE Fellow in 2007 and an OSA Fellow in 2009. He received the 2009 IEEE William Striefer Scientific Achievement Award. He is married to Neriko Musha and has two children.

SC105 Modulation Formats and Receiver Concepts for Optical Transmission Systems

Sunday, March 6, 2011
9:00 AM - 12:00 PM

Instructor: *Peter Winzer, Chandrasekhar Sethumadhavan; Bell Labs, Alcatel-Lucent, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The ever-increasing traffic demands in carrier networks, driven by emerging video services and other bandwidth-hungry applications, have led to intense research and development in the area of high-capacity (many Tbit/s), high-speed (100 Gb/s) optical transport networks. In order to enable such high capacities and speeds over appreciable transmission distances (>1000 km) in carrier

networks, spectrally efficient yet impairment-tolerant transmission technologies have moved into the focus of optical communications research and have led to considerable innovation in modulation and detection strategies. This course gives an overview of modulation formats and multiplexing techniques for optical networking applications, both from a conceptually fundamental and from a state-of-the-art technology point of view. The discussed modulation formats include intensity modulation, phase modulation, and quadrature modulation; multiplexing techniques include wavelength division multiplexing, polarization-multiplexing, and orthogonal frequency division multiplexing (OFDM). The course also covers optical receiver design and optimization principles, both for direct-detection and coherent (intradyne) receivers, including a discussion of digital electronic signal processing and coding techniques applied at transmitter and/or receiver. Finally, the course highlights the interplay of modulation format, receiver design, and the wide variety of transmission impairments found in optically routed long-haul networks.

Benefits:

This course should enable you to:

- Identify key objectives of high-capacity and high-speed optically routed network design.
- Describe the concepts behind optical modulation formats and multiplexing techniques.
- Generate advanced optical modulation formats using state-of-the-art opto-electronic components.
- Summarize the concepts behind optical receiver design, including direct and coherent detection as well as digital signal processing.
- Work with optical receiver performance attributes, such as “sensitivity” and “required OSNR.”
- Appreciate the trade-offs involved in designing and optimizing high performance optical receivers.
- Recognize the interplay between modulation format, receiver design, and transmission impairments.
- Get an insight into future trends regarding advanced modulation and multiplexing techniques and receiver concepts.

Audience:

This advanced-level course is intended for a diverse audience including lightwave system engineers and opto-electronic subsystem designers. Some basic knowledge of current optical modulation and detection technologies will help in better understanding the course. Past attendees will find substantial updates and may find it useful to attend the course again.

Instructor Biography:

Peter J. Winzer received his doctorate in electrical engineering/communications engineering from the Vienna University of Technology, Vienna, Austria, in 1998. His academic work, largely supported by the European Space Agency (ESA), was related to the analysis and modeling of space-borne Doppler wind lidar and highly sensitive free-space optical communication systems.

In this context, he specialized in optical modulation formats and high-sensitivity receivers using coherent and direct detection. He continued to pursue this field of research after joining Bell Labs in 2000, where he focused on Raman amplification, optical modulation formats, advanced receiver concepts, and digital signal processing techniques for 10, 40, and 100-Gb/s fiber-optic communication systems. Dr. Winzer is a member of the OSA and a Fellow of the IEEE.

Sethumadhavan Chandrasekhar received a doctorate in physics from the University of Bombay, Bombay, India, in 1985. He joined Bell Labs, Lucent Technologies (formerly AT&T Bell Labs), Holmdel, New Jersey, in 1986. He has worked on III-V compound semiconductor devices such as photodetectors, heterojunction phototransistors, bipolar transitors (HBTs) and high-speed optoelectronic integrated circuits (OEICs), advanced receive-side digital signal processing, novel modulation formats, and high-speed DWDM optical networking systems. His current activities include ROADMs, mesh optical networking, and hybrid DWDM 10G/40G/100G transmission. He is a Fellow of the IEEE.

SC341 OFDM for Optical Communications

Sunday, March 6, 2011
9:00 AM - 12:00 PM

Instructor: *Sander L. Jansen; Nokia Siemens Networks, Germany*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

In this short course the ins and outs of optical OFDM for fiber optical transmission systems will be discussed. The course will describe the principles of OFDM and the signal processing that is required for generation and detection. Different forms of OFDM will be described (both analogue and digital) and particularly the modulation and detection techniques for an optical OFDM signal will be explained. In addition, implementation aspects of optical OFDM are addressed: How can optical OFDM be generated and detected experimentally? How can imperfections of for instance the optical modulator and the 90 degrees hybrid be compensated for? Finally, in the last part of the short course, the optical performance of optical OFDM is addressed. What is the nonlinear performance and how can the nonlinear performance of optical OFDM be improved?

The course should enable attendees to get a feel for the different concepts and implementations of optical OFDM and their application scenarios.

Benefits:

This course should enable you to:

- Describe the concept of orthogonal frequency division multiplexing (OFDM) and its implementation.
- List the different kinds of optical OFDM that exist and detail the advantages and disadvantages of each method.
- Discuss concepts and components for the generation and detection of optical OFDM.
- Appreciate the design trade-offs of the cyclic prefix, FFT-size, etc. with respect to for instance the dispersion tolerance and oversampling.
- Explain the multi-input, multi-output (MIMO) technique that is required to equalize a polarization division multiplexed (PDM) signal.
- Describe concepts such as: IQ imbalance mitigation and phase noise compensation.
- Discuss different applications for optical OFDM: From access to long-haul transmission.

Audience:

This course is intended for engineers, researchers, and technical managers who like to gain a better understanding of optical OFDM and its applications. Apart from the theory and concepts behind optical OFDM, the implementation and system design will be discussed in detail as well. Participants should have a basic knowledge in the field of fiber-optic transmission systems; no previous knowledge of OFDM is required.

Instructor Biography:

Sander Lars Jansen is one of the pioneers in the field of optical OFDM for fiber-optic transmission systems. In 2007 he introduced a novel method for phase noise compensation and showed the first long-haul OFDM transmission experiment (4000km). Subsequently, in 2008 he was the first to realize 100-Gb/s per WDM channel. He authored and co-authored 10+ patents and more than 80 refereed papers and conference contributions. Dr. Jansen is an Associate Editor for PTL and an OFC committee member.

SC114 Passive Optical Networks (PONs)

Sunday, March 6, 2011
9:00 AM - 12:00 PM

Instructor: *Frank J. Effenberger; Huawei Technologies, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

PONs are experiencing solid double-digit growth as they become the key network approach for deploying Fiber to the Home (FTTH) and to other premises. It is important to understand the pros and cons of these networks, particularly what advantages they offer vs. active and point-to-

point alternatives. This includes knowing the tradeoffs among the three most common PONs: GPONs ("gigabit" PONs, which use a protocol evolved from ATM, the Asynchronous Transfer Mode), EPONs ("Ethernet" PONs, which use a modified Ethernet protocol), and WDM-PONs ("wavelength-division multiplexed" PONs, which assign a unique optical wavelength to each customer). All three, as well as other versions of PONs, can deliver today's triple-play services over a single, low-maintenance, future-proof network. This course examines and compares PON architectures, their transport protocols, their evolution to meet future needs, and CAPEX and OPEX considerations. Particular attention will be paid to the future systems that may begin standardization in the next few years.

Benefits:

This course should enable you to:

- Understand and discuss the capabilities and advantages of different PONs.
- Describe the pros and cons of ATM/GEM vs. Ethernet for broadband access.
- Know the motivations behind the Full-Service-Access-Network initiative and the related IEEE P802.3 and P1904 projects.
- Understand the relative importance of operations expenses (OPEX) compared with capital expenses (CAPEX).
- Have an overview of the possible future evolution paths that PON technology may take.

Audience:

This course is intended for engineers, network planners, and product designers involved with broadband access and a need to understand passive optical networks.

Instructor Biography:

After completing his doctoral work in 1995, Dr. Effenberger took a position with Bellcore (now Telcordia) where he analyzed all types of access network technologies, focusing on those that employed passive optical networks. He witnessed the early development of the FSAN initiative and the development of the APON standard. In 2000, he moved to Quantum Bridge Communications (now a part of Motorola), where he managed system engineering in their PON division. This work supported the development and standardization of advanced optical access systems based on B-PON and G-PON technologies. In 2006, he became Director of FTTx in the Advanced Technology Department of Huawei Technologies, USA. He remains heavily involved in the standards work, and is a leading contributor and editor of the major PON standards in the ITU. In addition, his work has turned toward more forward-looking fiber access technologies, including the 802.3av 10G EPON and ITU NGA topics.

SC239 Short-Reach Optical Interconnects

Sunday, March 6, 2011
9:00 AM - 1:00 PM

Instructor: *Steve Joiner; Finisar, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course will present an overview of short-reach optical interconnect technology, from traditional LED-based Ethernet transceivers all the way to high-density multichannel solutions now being investigated for multi-Terabit/s optical backplanes. Material will include applications and standards, basic component technologies (e.g. optoelectronics, IC's, optics, packaging, connectors), the basics of optical link analysis (e.g. power budgets, eye-diagrams, link penalties), and a survey of high-bandwidth, short-reach optical interconnect solutions including serial, parallel optics and coarse WDM.

Benefits:

This course should enable you to:

- Determine the suitability of optical interconnects for system applications.
- Compare technology options for short-reach optical interconnects.
- Compute a simple optical power budget.
- Identify the components best suited for a given optical interconnect application.
- Explain short-reach optical interconnect technology to system engineers and management.

Audience:

This introductory course is intended for an audience with at least some technical background in engineering, physics or related disciplines, and is ideally suited for engineers from related fields in optics, electronics, networking or computing systems who want to learn more about short-reach optical interconnects. Marketing or business development professionals seeking a deeper understanding of the technology may also consider taking this course.

Instructor Biography:

Steve Joiner has been developing products for emerging fiber-optic communication applications for 25 years. Steve currently works with Finisar Corp. Prior to joining Finisar, Steve was

Director of Marketing for pluggable transceivers at Bookham. Steve works with both customers and standards bodies to create the best application of technology to meet market needs. Steve joined Hewlett-Packard in 1978, working in III-V devices, fiber-optic cable fabrication, fiber-optic transceiver development, and standards development. He was Program Manager for HP's first 1300-nm LED transceiver for the ESCON and FDDI markets. Later, he was responsible for all fiber-optic product development, then moved into technology planning and pre-competitive collaboration. In 1999 he joined the newly-formed Agilent Technologies Corporate Laboratory, where he managed the Network Architecture and Technology Department. He has chaired numerous standards committees, participating in the development of several multi-source agreements for fiber-optic packaging. Steve earned his B.A., M.A., and Ph.D. degrees in physics from Rice University in Houston.

SC288 Fundamentals of Polarization, PMD and PDL in Lightwave Systems

Sunday, March 6, 2011
9:00 AM - 1:00 PM

Instructor: *Robert Jopson; Bell Labs, Alcatel-Lucent, USA*

Level: TBD

Description:

Polarization phenomena has become increasingly important as greater performance is extracted from lightwave systems. This course is designed to provide an understanding of the various aspects of polarization that affect component specification and system performance. In the first hour of this four-hour course, we review fundamental elements of polarization, including linear, circular, and elliptical polarization, their descriptions using Jones and Stokes formalism, as well as unpolarized and partially polarized light. After this review, we look at fiber and component properties such as birefringence, polarization-dependent loss (PDL), and polarization-mode dispersion (PMD). The influence on polarization of standard single-mode fiber (SMF), polarization-maintaining fiber (PMF), and splices in PMF can now be understood. Polarization components such as polarizers, polarization beam splitters, polarization controllers, and polarization scramblers as well as polarization-analyzing instruments will be discussed. Finally, we will discuss the influence of PMD on lightwave system performance and mention methods of reducing impairment caused by PMD. Where possible, an intuitive description will be used rather than a mathematical description; however, Jones and Stokes formalism as well as the more intuitive Poincaré sphere will be shown.

Benefits:

This course should enable you to:

- Describe polarization evolution in optical fiber.
- Compare Jones vectors, Stokes vectors and the Poincaré sphere.

- Specify polarization-axis alignment tolerance for components and splices using polarization-maintaining fiber (PMF).
- Describe the use of a polarization-analyzing instrument.
- Explain polarization-dependent loss (PDL).
- Describe the origins of polarization-mode dispersion (PMD).
- Determine PMD-induced outage probability in uncompensated lightwave systems.

Audience:

This course is intended for engineers, technicians, and managers working with systems or instruments affected by polarization. Participants should have a basic understanding of the nature of light or other electromagnetic waves.

Instructor Biography:

Robert Jopson received a bachelor's degree in physics from the University of California at Davis and a doctorate degree in physics from Harvard University. Since 1983 he has worked on lightwave systems at Bell Labs in Holmdel, New Jersey. He has worked on semiconductor optical amplifiers, reflections in lightwave systems, high-speed transmission systems, polarization-mode dispersion, and fiber parametric gain.

SC216 An Introduction to Optical Network Design and Planning

Sunday, March 6, 2011
1:00 PM - 4:00 PM

Instructor: *Jane M. Simmons; Monarch Network Architects, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course is an introduction to optical network design and planning for backbone, regional, and metro-core networks. A fundamental aspect of any optical network design is selecting the proper network elements to maximize flexibility and adaptability for future growth, while minimizing cost. The course will discuss the role of network elements, such as ROADMs, multi-degree ROADMs, and optical switches, and describe where each element fits in a network. It will address the benefits of equipment features such as “colorless” and “directionless.” Various case studies illustrating technology tradeoffs will be presented.

Routing and wavelength assignment play an important role in the efficiency of networks based on these optical elements. The course will cover the principles of routing and wavelength

assignment, including a description of some of the relevant algorithms. The role of regeneration and optical reach in network design will be discussed in some detail. Modeling for real-time planning will also be covered.

Many of the principles of the course will be illustrated through an interactive design session with a commercial optical network design tool.

Benefits:

This course should enable you to:

- Compare O-E-O and optical-bypass technology.
- Compare the architectures of various optical network elements.
- Determine the proper optical equipment for a particular network site, based on nodal degree and traffic patterns.
- Describe the basics of routing traffic, including strategies for diversity and load balancing.
- Describe the basics of wavelength assignment.
- Enumerate some of the networking principles as well as physical effects that determine where regeneration is required in a network.
- Determine the optimal optical reach for a given network and set of traffic demands.
- Compare real-time vs. long-term network planning.

Audience:

This course is intended for network planners and architects in both carriers and system vendors who are involved in planning optical networks and selecting next-generation optical equipment. The discussion of networking elements and algorithms should be helpful to vendors who are developing optical systems, as well as to carriers who are modeling network evolution strategies. The course is introductory level, although a basic understanding of networking principles is assumed.

Instructor Biography:

Jane Simmons is a founding partner of Monarch Network Architects, which provides optical network architectural services and tools for carriers and system vendors. Prior to founding Monarch, she was Executive Director of Network Planning and Architecture at Kirana Networks. From 1999 to 2002, she worked at Corvis, as the Executive Engineer of Network Architecture, and later as the Chief Network Architect. At both Kirana and Corvis, she developed the algorithms to optimally plan advanced optical networks and was responsible for all customer network designs. She performed the network design and the link engineering for the Broadwing network, the first commercially deployed all-optical backbone network. From 1993 to 1999, Dr. Simmons worked at AT&T, where she conducted research on backbone, regional, and broadband access networks. She received a B.S.E., Summa Cum Laude, from Princeton University, and S.M. and Ph.D. degrees from MIT, all in electrical engineering.

SC203 40/100 Gb/s Transmission Systems, Design and Design Trade-offs

Sunday, March 6, 2011
1:00 PM - 4:00 PM

Instructor: *Martin Birk[1], Benny Mikkelsen[2]; [1]AT&T Labs–Res., USA, [2]Acacia Communications, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Commercial mass deployments of 40G have primarily happened in service provider's backbone networks. However, it is expected that 40G deployments will soon move into regional and metro networks imposing a different set of system and cost requirements than backbone applications. At the same time, carriers are already preparing for 100G transport in their backbone networks. This course will cover both 40G metro-regional networks as well as emerging 100G backbone applications.

The first part of this course provides an overview of the drivers and applications of 40G transmission systems in regional and metro networks. It describes the requirements and expectations carriers will have to cost, power consumption, footprint, reliability, optical performance, and interoperability of 40G systems. In the second part, we discuss emerging 100G backbone applications and technologies. In both parts, we present practical design issues of 40/100G line-cards, and we critically review the availability and performance of the key building blocks. In particular, we discuss the technologies needed to implement different modulation formats, and the corresponding trade-off between complexity/cost of line-card implementations and the achievable fiber transmission distance.

Benefits:

This course should enable you to:

- Identify key requirements and drivers for 40/100 Gbit/s applications.
- Describe the availability and performance of 40/100 Gbit/s key building blocks.
- Discuss 40/100 Gbit/s transmission limitations.
- Describe lessons learned from 40/100 Gbit/s field trials.
- Summarize 40/100 Gbit/s standards activities.

Audience:

The course is intended for engineers and technical managers who want an up-to-date overview of 40G/100G transmission systems, including applications, line-card designs, and fiber transmission limitations. It was significantly updated in 2009, and past attendees may find it useful to take the course again. The course requires some understanding of basic optical transmission systems.

Instructor Biography:

Martin Birk received his master's and doctorate degrees from Germany's University of Ulm in 1994 and 1999, respectively. Since 1999, he has been with AT&T Labs-Research in New Jersey, working on high-speed optical transmission at data rates of 40Gbit/s and above.

Benny Mikkelsen is co-founder and CTO at Acacia Communications, where he is responsible for the design of 100 Gbit/s optical transport products. Before Acacia, he co-founded Mintera and earlier was with Bell Labs, Lucent Technologies, where his research included ultra high-speed optical transmission. He holds master's and doctorate degrees in electrical engineering from the Technical University of Denmark.

SC267 Silicon Microphotonics: Technology Elements and the Roadmap to Implementation

Sunday, March 6, 2011
1:00 PM - 4:00 PM

Instructor: *Lionel Kimerling; MIT, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The optical components industry stands at the threshold of a major expansion that will restructure its business processes and sustain its profitability for the next three decades. This growth will establish a cost-effective platform for the partitioning of electronic and photonic functionality to extend the processing power of integrated circuits and the performance of optical communications networks. The traditional dimensional shrink approach to the scaling of microprocessor technology is encountering barriers in materials and power dissipation that dictate more distributed architectures. Before 2015 the performance requirements for this short link interconnection will cross the 10Mb/s.km threshold that dictates optical carrier utilization. This business direction will ignite a major change in leadership of the industry from information transmission (telecom) to information processing (computing, imaging); and it will open significant new markets with high-volume applications. Silicon microphotonics is a platform for the large-scale integration of CMOS electronics with photonic components. This course will evaluate the most promising silicon optical components and the path to electronic-photonic integration. The subjects will be presented in two parts: 1) Context: a review of the recently

released Communications Technology Roadmap by the Industry Consortium of the MIT Microphotonics Center; and 2) Technology: case studies in High Index Contrast design for silicon-based waveguide, filter, photodetector, modulator, and laser devices. The objective of the course is to present an overview of the silicon microphotonic platform drivers and barriers in design, fabrication, packaging, and test.

Benefits:

This course should enable you to:

- Identify trends in the optical components industry.
- Explain the power of a standard platform.
- Discuss the benefits of electronic-photonic integration.
- Evaluate the latest silicon photonic devices.
- Summarize the findings of the Communications Technology Roadmap.

Audience:

This course is for executives and technologists in the optical components industry to include planners, engineers, and scientists participating in the optical components technology supply chain.

Instructor Biography:

Lionel Kimerling is the Thomas Lord Professor of Materials Science and Engineering at MIT. He was head of materials physics research at Bell Labs until 1990, when he joined MIT. He is currently Director of the MIT Materials Processing Center and its affiliate, the MIT Microphotonics Center, which he co-founded with 30 faculty members in 1997. Among his industry responsibilities were long-term reliability of semiconductor lasers, development of the first 1MB DRAM chip, and defect diagnostics and control for silicon IC manufacturing. His group's research has focused on silicon microphotonics, environmentally benign IC manufacturing, and solar electricity.

SC328 New Developments in Optical Transport Networking (OTN)

Sunday, March 6, 2011
1:00 PM - 4:00 PM

Instructor: *Stephen Trowbridge; Alcatel-Lucent, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course provides an introduction to revised ITU-T Recommendation G.709/Y.1331, *Interfaces for the Optical Transport Network (OTN),* focusing on new interfaces and capabilities for OTN in the first major revision of the standard since 2003. As DWDM networks have evolved, they have provided a common convergence layer for SONET/SDH, IP, and Ethernet traffic. The latest version of the standard helps move from a combination of point-to-point DWDM line systems and metro ROADM networks to a full, end-to-end managed network. The OTN hierarchy has been extended "at both ends," adding a new lower tier (ODU0) optimized for the transport of 1000GBASE-X (Gigabit Ethernet), and a new upper tier (ODU4) optimized for the transport of the new 100GBASE-R (100 Gigabit Ethernet) recently specified by the IEEE P802.3ba project. Mapping is specified for the new 40GBASE-R (40 Gigabit Ethernet) signal into existing 40G transport using the currently deployed ODU3. OTN is being deployed by many operators for their next generation network builds. This course will cover the basic concepts of G.709, with specific emphasis on the recently added interfaces and capabilities. You will learn how IP, Ethernet, and SONET/SDH traffic can be carried by an international standard based digital wrapper solution. You will develop an appreciation for the flexibility provided in the latest OTN standards to transport a wide variety of client signals and to efficiently manage bandwidth.

Benefits:

This course should enable you to:

- Understand the concepts that form the basis for an OTN based on G.709.
- Learn about the new interfaces provided in the latest revision of the standard.
- Apply the capabilities of the OTN standards to manage client signals and wavelengths.
- Understand the mapping mechanisms used by OTN to transport major client signals.
- Utilize the new flexibility of the latest standard for efficient bandwidth management.
- Know where to look to find more information about G.709.

Audience:

This course is intended for anyone who designs, operates, or supports metro and/or long haul optical networks and who need to understand the new interfaces and capabilities in ITU-T Recommendation G.709 and how they can be used.

Instructor Biography:

Dr. Stephen J. Trowbridge is a Consulting Member of Technical Staff (CMTS) at Alcatel-Lucent. He received his B.S. (EE&CS), M.S. (CS), and Ph.D. (CS) from the University of Colorado, Boulder. He joined Bell Laboratories–AT&T (now Alcatel-Lucent) in September 1977. He has been active in optical networking standardization since 1995. He is vice-chair of

ITU-T TSAG, chairman of ITU-T Working Party 3/15 (responsible for OTN standards including G.709), chairman of the ATIS COAST-OHI working group, and a was a member of the IEEE P802.3ba editorial team.

SC357 Computercom Interconnects: Circuits and Equalization Methods for Short Reach Power and Cost-Optimized Optical and Electrical Links

New Course!

Sunday, March 6, 2011
1:00 PM - 4:00 PM

Instructor: *Alexander Rylyakov; IBM T.J. Watson Res. Ctr., USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

We live in a computercom interconnect era, when optics is displacing wireline links at ever shorter distances inside large-scale computer and switch/router systems. Each optical link, however, begins and ends with a short electrical link, so both communication channels will co-exist for the foreseeable future. It is extremely important, therefore, to understand the power dissipation, area/density, and cost tradeoffs involved in selecting one solution over another.

We will start with outlining the basics of channel properties and communication techniques. We will then review the most common front-end I/O circuit topologies used in both optical and electrical short reach interconnects and compare their overall efficiencies. Typical transmitter and receiver architectures for both electrical and optical links will be presented, with discussion of basic functionality and performance requirements for each of the building blocks. We will outline the similarities as well as the differences between the key front-end components (e.g., VCSEL driver vs. line driver, TIA vs. receiver amplifier, etc.), and their effect on the overall link performance. The review will also include the discussion of the high-speed digital MUX/DEMUX (serializer/deserializer) circuits and the CDR (clock and data recovery) function. We will also compare the most commonly used SiGe bipolar and CMOS technologies in terms of performance, power dissipation, area, and cost.

Electrical links have to employ heavy-duty equalization techniques due to severe bandwidth limitations of wireline channels, but optical solutions can also benefit from, and often include, some form of equalization, even at short reach. We will discuss several commonly used equalization methods, including feed-forward equalizers (FFE, typically employed in the transmitter pre-emphasis), decision-feedback equalizers (DFE, commonly present in the receiver), and peaking amplifiers (often used on both sides of the link). High-level descriptions of several topologies of FFE transmitters and DFE receivers will be presented, together with a discussion of tradeoffs involved when selecting one over another, or using both.

Benefits:

This course should enable you to:

- Outline overall transceiver architectures of typical wireline and optical short reach links.
- Explain functionality and performance requirements of all key front-end I/O building blocks.
- Evaluate and compare the efficiencies of wireline and optical short reach interconnects.
- Compare SiGe bipolar and CMOS circuits for short reach optical and electrical links.
- Understand and compare equalization techniques (FFE, DFE, peaking amplifier).
- Discuss benefits and tradeoffs of equalization.
- Make an educated choice between an optical and electrical solution for short reach interconnect.

Audience:

This course is for anyone interested in learning the basic transmitter and receiver circuit architectures for both optical and electrical short reach interconnects. The course will help attendees gain insight into the main tradeoffs involved in choosing between the optical and electrical links, as well as the integrated circuit topologies and technologies used in the transceiver circuits. The overview of advanced equalization techniques will be also of interest to audiences already familiar with the basics of short reach interconnect.

Instructor Biography:

Alexander Rylyakov received an M.S. degree in physics from Moscow Institute of Physics and Technology in 1989 and a Ph.D. degree in physics from State University of New York at Stony Brook in 1997, where he worked on the design and testing of superconductor integrated circuits based on Josephson junctions. In 1999 he joined the IBM T. J. Watson Research Center as a research staff member, working on the design and testing of high-speed digital and mixed-signal communication circuits for optical and channel-limited wireline communications. Many of those circuits, implemented in various generations of CMOS and SiGe bipolar, are now used in IBM products and several of them have established performance records in their respective technologies. Dr. Rylyakov's current research interests are in the areas of digital phase-locked loops for communication and microprocessor clocking, high-speed low power transceivers and equalization for wireline and optical communication, and integrated circuits for silicon photonics. He has published over 60 papers and has received 10 patents.

SC177 High-Speed Semiconductor Lasers and Modulators

Sunday, March 6, 2011
1:00 PM - 4:00 PM

Instructor: *John Bowers; Univ. of California at Santa Barbara, USA*

Level: Intermediate (prior knowledge of topic is necessary to appreciate course material)

Description:

Amplitude and phase modulation of light for transmission at 10, 40. and 100 Gbit/s is a critical problem for fiber-optic networks. We will review the basic concepts of optical modulators, with emphasis on electroabsorption modulators. The fundamental physics and design of modulators will be reviewed. The microwave characteristics of semiconductor lasers, important for high-speed digital and analog applications, are presented. From the rate equations for electron and photon dynamics in the laser we derive fundamental limits to laser bandwidth. These limits include resonance limits, damping, transport effects, and device parasitics. Methods to increase the bandwidth are illustrated with examples from literature, along with results showing the current state of the art. Finally, analog and large-signal modulation issues important for applications in communication systems are covered, including ringing, chirp, intensity noise, and distortion.

Benefits:

This course should enable you to:

- Compare different technologies.
- Make informed decisions on the design of optical transmitters and their incorporation into optical networks.
- Explain the performance of high-speed transmitters.

Audience:

Attendees should have some knowledge of semiconductor and device physics. A basic knowledge of laser operation is also needed.

Instructor Biography:

John E. Bowers is Director of the Institute for Energy Efficiency and an electrical and computer engineering professor at the University of California at Santa Barbara. He received his master's and doctorate degrees from Stanford University. He previously worked for Bell Labs and Honeywell. He is a member of the National Academy of Engineering and a Fellow of the IEEE, OSA, and American Physical Society. He is a recipient of the IEEE/LEOS William Streifer Award. He has published nine book chapters, 500 journal papers, and 600 conference papers and has received 50 patents.

SC259 Electronic and Optical Impairment Mitigation

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Instructor: *Chris Fludger[1], Seb Savory[2]; [1]CoreOptics GmbH, Germany, [2]Univ. College London, UK*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

As the channel bit-rate increases from 10 Gbit/s to 40 and 100 Gbit/s, chromatic dispersion (CD) and polarization mode dispersion (PMD) become visible as limiting properties of optical network links. Next-generation transmission equipment needs to be both affordable and tolerant to impairments in the channel. This course compares and contrasts electronic equalization and optical compensation techniques. The principle of electronic impairment mitigators such as feed-forward and decision feedback equalizers or Maximum-Likelihood Sequence Estimators will be explained and their performance compared. Electronic compensation using transmitter pre-distortion or coherent detection will also be discussed. These will be contrasted against more traditional optical compensation devices for CD and PMD.

Benefits:

This course should enable you to:

- Explain the requirement for dynamic impairment mitigation devices.
- Explain the major options for electronic equalizers and optical PMD compensators.
- Describe the building blocks and operation of electronic equalizers.
- Explain analogue and digital electronic signal processing.
- Explain the difference between electronic equalizers that operate on the optical field, and those that use the directly detected signal.
- Quantify the performance of the different PMD and CD compensators.
- Discuss the advantages and disadvantages of optical and electronic mitigation.

Audience:

This course is intended for individuals having a basic knowledge of digital lightwave transmission systems. It will be of value for industrial professionals (system designers, managers) who need to assess the different options of electronic and optical impairment mitigators, as well as for researchers who are new to the field.

Instructor Biography:

Chris Fludger has received master's and doctorate degrees in electronics engineering from Cambridge University, UK. At Nortel Networks he has worked on electronic signal processing, advanced modulation techniques, and Raman amplification. He is currently working at CoreOptics, developing next-generation 10G, 40G, and 100G optical transmission modules for open tolerant networks.

Seb Savory received master's and doctorate degrees in engineering from Cambridge University, UK, and the M.Sc. (Maths) degree from the Open University, UK. He is a lecturer at University College London, where his research is focused on digital coherent receivers. Previously he was at Nortel, where he worked on PMD compensation, coherent detection, and DSP.

SC327 Modeling and Design of Fiber-Optic Communication Systems

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Instructor: *Rene-Jean Essiambre; Bell Labs, Alcatel-Lucent, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The broad objective of this course is to provide a working knowledge of the numerous techniques and tools used to design the transport layer of advanced fiber-optic communication systems, from metropolitan to ultra-long haul systems. The primary focus is on providing a comprehensive overview of how to model propagation over optical fibers, with emphasis on the various fiber nonlinear effects involving signal and noise, for both singly-polarized and polarization-division-multiplexed signals. This includes a description of the techniques suitable for modeling nonlinear propagation of various advanced modulation formats in optically routed networks. The course also provides a comparative description of various optical amplification technologies, such as erbium-doped and Raman amplification, for different types of transmission lines. A description of the tools used to characterize system performance is covered in this course, including evaluations of optical signal-to-noise ratio (OSNR) penalties and Q-factors. In addition, the course presents an introduction to the issues faced when configuring the physical layer of optical networks, including ring and mesh network topologies. Finally, the course concludes with an overview of the ultimate capacity of the "fiber channel" that helps participants understand technological limits associated with increasing the capacity of fiber-optic communication systems.

Benefits:

This course should enable you to:

- Develop a functional understanding of the basic building blocks of fiber-optic communication systems.
- Learn the basic elements of optical transmission modeling.
- Develop a detailed understanding of how to model nonlinear transmission over fibers, especially how to navigate through the numerous pitfalls of nonlinear transmission modeling.
- Choose a suitable technique for modeling specific systems, such as systems using advanced modulation formats.
- Compare the performance of various amplification technologies.
- Understand the basic technical issues faced when configuring optical networks with complex topologies.
- Estimate the ultimate limit to fiber capacity.

Audience:

This course is intended for engineers and scientists working on fiber-optic transmission as well as those working on components and subsystems interested in developing an expertise at the transmission level. The course also addresses academic researchers and graduate students with basic knowledge on optical or digital communication interested in developing a detailed knowledge of fiber-optic transmission modeling and in understanding system implications of advanced technologies.

Instructor Biography:

René-Jean Essiambre is a Distinguished Member of the Technical Staff at Bell Labs, Alcatel-Lucent. He received his doctorate from Université Laval and studied at the University of Rochester before joining Lucent Technologies (now Alcatel-Lucent) in 1997. Essiambre is contributing to the design of advanced optical transmission systems, especially in relation to the management of fiber nonlinearities. His interests include modulation formats, detection and optimization techniques for the design of optically routed networks to increase capacity, optical transparency, and functionality of wavelength-division multiplexed communication systems. He is a recipient of the 2005 Engineering Excellence Award from OSA, where he is a fellow.

SC243 Next Generation Transport Networks: The Evolution from Circuits to Packets

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Instructor: *Ori A. Gerstel; Cisco Systems, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Transport networking technologies are experiencing one of the most significant evolutionary pressures in recent history. While previous phases in the evolution of the transport layer were driven by operations considerations (SONET/SDH) and bandwidth growth (WDM), the current phase is driven by fundamental shifts in services from circuits to packets. Services like VoIP and VoD have a profound impact on how the network is architected and managed. The challenge is compounded by an order-of-magnitude increase in bandwidth demands from the end-user and by the large number of unknowns, both from a service type perspective and bandwidth sizing and distribution perspective. As a result, service providers and equipment vendors alike are struggling with the best long-term architecture to the new transport layer and with the need for a smooth migration path form their legacy systems to that long-term solution. This course attempts to add clarity to the new requirements for the transport layer and the different technologies that are being considered to address these requirements. The course starts with a review of new services that must be supported by the transport layer, including Metro Ethernet services, storage services, and triple play services (mainly Internet/VOIP/VoD). We then proceed to discuss the current transport technologies, such as legacy IP, Ethernet, SONET/SDH and DWDM, and their drawbacks for the new offered services. Each legacy technology has been extended recently in support of the new demands. In particular, Carrier-class IP, MPLS-TP, Metro Ethernet, PBB-TE, OTN, and automated DWDM systems are being considered. We will clarify the innovation and capabilities that make these technologies more appropriate and how they can be combined into effective network architectures.

Benefits:

This course should enable you to:

- Understand transport technologies from L3 to L0: IP, MPLS, Ethernet, TDM, and WDM.
- Describe new enterprise services: point to point and point to multi-point Ethernet and Storage services.
- Understand triple play services and their requirements: VOIP, digital video and VoD, internet access.
- Understand next-gen SONET and the evolution of OTN.
- Compare MPLS, Ethernet, PBB-TE, MPLS-TP.
- Describe access and core networking from a transport perspective.
- Understand the interplay between the IP layer and the underlying transport technology.

Audience:

This course is intended for the general OFC/NFOEC audience, including network planners, architects, product line managers, and other professionals, as well as researchers working on electrical and optical technologies for the carrier’s transport layer.

Instructor Biography:

Ori Gerstel (F’08) is a Senior Technical Leader at Cisco. His main role is to define the architecture of IP and optical networks integration (IPoDWDM). Prior to that, he was in charge of Cisco's advanced optical technology team. He is the key inventor behind some of the advanced capabilities of Cisco’s DWDM product. Before joining Cisco in 2002, he was a Senior Systems Architect for Nortel's photonic crossconnect. Before joining Xros/Nortel, Gerstel was the Systems And Software Architect for the Optical Networking Group at Tellabs, where he architected the first commercial mesh DWDM system. Previously, he performed early optical networking research at IBM Research. He authored more than 50 papers for international conferences and journals and over 20 patents. He served on the program committee of various conferences and journals and is an invited speaker to many panels, tutorials. and courses. He holds a Ph.D. from Technion–Israel Institute of Technology, Israel.

SC217 Hybrid Fiber Radio: The Application of Photonic Links in Wireless Communications

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Instructor: *Dalma Novak; Pharad, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The use of optical fiber links for the transport and distribution of radio signals in wireless networks is becoming increasingly prevalent. Applications where such hybrid technology is now being used include backhaul for cellular networks; indoor distributed antenna systems; as well as fixed and mobile broadband and ultrabroadband networks capable of providing users with very high bandwidth services.

This short course presents an overview of how and where photonic links are finding application in wireless communication networks. The associated technologies, devices, sub-systems, and system architectures that enable the implementation of integrated wireless and wireline (optical) networks will be discussed. The various technical challenges and issues that must be addressed for the successful integration of these networks, which encompass very different requirements and specifications, will also be presented. Topics to be covered include:

- Integrated optical/wireless network architectures.
- Requirements and challenges for the development of hybrid fiber radio systems.
- Relevant technologies and implementation approaches.

Benefits:

This course should enable you to:

- Understand the motivation for the integration of wireless communication systems with optical fiber networks.
- Identify the technical challenges related to the application of photonics and optical networking concepts to wireless communications.
- Understand and compare physical layer technologies that enable the integration of wireless and optical networks.
- Identify technologies that can improve the performance of integrated optical and wireless networks.
- Establish the tradeoffs with alternative integrated network architectures.

Audience:

This is an intermediate course for people working in telecommunication-related areas who wish to broaden their knowledge and learn how optical networks are being integrated with wireless communications or find out the current status of this multidisciplinary field.

Instructor Biography:

Dalma Novak is Vice President at Pharad, LLC, which is developing advanced RF-over-fiber and antenna products. She received her Ph.D. in electrical engineering in 1992. From 1992–2004 she was a faculty member in the Department of Electrical and Electronic Engineering at The University of Melbourne, Australia. Previously Dr. Novak held positions at Dorsal Networks and Corvis Corporation. Dr. Novak is a Fellow of the IEEE and has published over 250 papers in the area of hybrid fiber radio technologies.

SC265 Passive Optical Components and Filtering Technologies

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Instructor: *Bruce Nyman[1], Christi Madsen[2]; [1]Tyco Electronics SubCom, USA, [2]Texas A&M Univ., USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

Today's WDM networks rely on subsystems, such as ROADMs and erbium-doped fiber amplifiers, and incorporate many types of passive components. For example, a typical optical amplifier will contain an isolator, a pump and signal multiplexer, optical taps, and a gain flattening filter. In this Short Course, we will discuss the passive components found in a typical

WDM system. For each one, students will be able to identify the system requirements on device performance and assess the technology options for meeting those requirements. While passive devices may be simple in function, choosing and specifying them can be challenging. Performance issues such as insertion loss, return loss, polarization-dependent loss, polarization mode dispersion, and chromatic dispersion are important, as are temperature and wavelength dependencies. Component fabrication techniques, including fused fiber, dielectric filters, planar waveguide, and fiber Bragg gratings are surveyed, with an emphasis on their relative strengths and weaknesses. For effective specification and system design, accurate measurements are critical. An understanding of the various measurement methods and issues will be provided. A fundamental understanding of optical filters will be addressed in the course. We take a signal processing approach, which allows us to compare the properties of such diverse filters as waveguide grating routers, Fabry-Perot etalons, ring resonators, and thin-film filters. The source of chromatic dispersion in filters and its relationship to their magnitude response will be discussed. Optical filter applications will be presented, including signal conditioning applications such as tunable dispersion compensation, as well as optical sensing applications.

Benefits:

This course should enable you to:

- Identify the device requirements and technology options of the passive components in a WDM system.
- Compare filter choices for applications, such as chromatic dispersion compensation and monitoring.
- Define specifications for passive components to meet system requirements.
- Understand the various measurement methods and important parameters.
- Explain the basic commonality and differences between optical filter types.
- Identify the trade-offs to obtain a more idealized, dispersionless, boxlike spectral response.

Audience:

This course is for those who need an introduction into the various types of optical components and filters used in WDM systems, including practitioners and technical managers responsible for system design, integration, and testing, as well as those who need to deliver and verify components for WDM systems.

Instructor Biography:

Bruce Nyman is currently with Tyco Electronics SubCom where he develops next-generation undersea systems. From 2005 to 2009 he was with Princeton Lightwave as Vice President of System Solutions. Previously, he developed optical amplifiers and measurement equipment at JDS Uniphase and optically amplified undersea systems at Bell Labs. He received his doctorate from Columbia University and is a member of the IEEE and Sigma Psi.

Christi Madsen is a professor at Texas A&M University, focusing on photonic processing for optical communications and sensing. Previously, she was a Distinguished MTS with Bell Labs. She is an OSA Fellow, coauthored *Optical Filter Design and Analysis: A Signal Processing Approach*, holds 30 patents, and has published numerous papers.

SC178 Test and Measurement of High-Speed Communications Signals

Monday, March 7, 2011
8:30 AM - 12:30 PM

Instructor: *Greg LeCheminant; Agilent Technologies, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The ability to accurately characterize signals and waveforms is an essential element in the development and manufacturing of high-speed communications components and systems. This course will emphasize measurement tools and techniques to characterize signal quality and how well it is maintained when transmitted through an optical system. It will focus on four measurement areas: bit-error-ratio (BER) analysis, oscilloscope waveform analysis with emphasis on the eye diagram, jitter analysis, and the analysis of complex modulated signals. The basics for each measurement type will be covered, gradually building to the more difficult aspects of measurements, including common measurement problems and their solutions. Results from tests performed on actual components and systems using BERTs, high-speed sampling oscilloscopes, and jitter test sets will be presented. The course will emphasize research and development and manufacturing measurements of components and subsystems instead of installation and maintenance test.

Benefits:

This course should enable you to:

- Determine the relationships between BER, eye-diagrams, and jitter tests.
- Avoid common mistakes that degrade measurement accuracy.
- Define the relationship between Q-factor and BER.
- Identify ways to increase test efficiencies.
- Develop test strategies to verify compliance to industry standards.
- Compare the different approaches to characterizing jitter and recognize what the results imply in a systems context.
- Define and measure the parameters used to quantify the quality of complex modulation-based systems.

Audience:

This course is appropriate for engineers, technicians, and scientists who have a basic or higher knowledge of high-speed communications systems and signals. A basic knowledge of common laboratory measurement instrumentation will be helpful.

Instructor Biography:

Greg LeCheminant holds B.S.E.E.T. (1983) and M.S.E.E. (1984) degrees from Brigham Young University. He began work for Agilent Technologies/Hewlett-Packard in 1985 as a microwave circuits manufacturing development engineer. Since 1989, he has been involved in the development of measurement tools and applications for high-speed digital communications signals and systems with an emphasis in optical transmission.

SC102 WDM in Long-Haul Transmission Systems

Monday, March 7, 2011
8:30 AM - 12:30 PM

Instructor: *Neal S. Bergano; Tyco Telecommunications, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

Wavelength division multiplexing (WDM) technology used in long-haul transmission systems has steadily progressed over the past few years. Newly installed state-of-the-art transoceanic systems now have terabit/s maximum capacity, while being flexible enough to have an initial deployed capacity at a fraction of the maximum. The steady capacity growth of these long-haul fiber-optic cable systems has resulted from many improvements in WDM transmission techniques and an increased understanding of WDM optical propagation. Important strides have been made in areas of dispersion management, gain equalization, modulation formats, and error correcting codes that have made possible the demonstration of multi-terrabit capacities over transoceanic distances in laboratory experiments. Next-generation systems and future upgrades of existing systems will benefit from these new concepts emerging from system research.

This course will review the important issues regarding the use of WDM in long-haul transmission systems. Included will be an introduction to long-haul undersea transmission systems, the amplified transmission line, dispersion/nonlinear management, transmission formats, measures of system performance, forward error correction, the importance of polarization effects, experimental techniques and results, a transmission line design example and

future trends. Next-generation systems and future upgrades of existing systems will benefit from these new concepts emerging from system research.

Benefits:

This course should enable you to:

- Explain the tradeoffs made in the design of an amplifier chain.
- Summarize the tradeoffs made in the selection of dispersion maps.
- Identify the methods used to measure system performance, such as Q-factor.
- Identify the important polarization effects in long-haul transmission systems.
- Compare the different methods of performing long-haul transmission experiments.
- Discuss circulating loop experiments.
- Discuss the future trends in long-haul transmission systems.
- Gain insight into the optical propagation of data signals over long distances.

Audience:

This course is intended for the student who wants an understanding of how information is transmitted over long distances using fiber optic transmission lines. This includes new entrants into the fiber optic field with an engineering background, engineers with fiber optics exposure, people in the fiber optic telecommunications industry, and fiber optic research and development management.

Instructor Biography:

Neal S. Bergano is Managing Director of System Research and Network Development at TE SubCom. In 1981 he received a B.S.E.E. degree from the Polytechnic Institute of New York, and then joined the technical staff of Bell Labs' undersea systems division. In 1983 received an M.S.E.E. degree from the Massachusetts Institute of Technology. In 1992 he was named a distinguished member of the technical staff of AT&T Bell Labs. In 1996 he was promoted to AT&T Technology Consultant. In 1997 he was promoted to AT&T Technology Leader.

Neal is on the Board of Directors for The Optical Society and has served on the Board of Governors for IEEE LEOS from 1999 to 2001. Neal is a long-time volunteer and supporter of the OFC/NFOEC meeting, which includes serving as Chair and Co-chair in 1999 and 1997, Chair of the Steering Committee from 2000 to 2002, and currently as Chair of OFC/NFOEC’s long-range planning committee.

Neal is a Fellow of the IEEE, OSA, AT&T, and Tyco Electronics and holds 31 US patents in the area of lightwave transmission systems. Neal Bergano is the recipient of the 2002 John Tyndall Award "for outstanding technical contributions to and technical leadership in the advancement of global undersea fiber optic communication systems."

SC342 Digital Coherent Optical Communications

Monday, March 7, 2011
8:30 AM - 12:30 PM

Instructor: *Maurice O'Sullivan; Ciena, Canada*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Transmission systems operating at 40 Gb/s and 100 Gb/s, including network spectral efficiencies above 1 b/s/Hz, are being installed to address the need for capacity in long haul optical networks. Coherent transmission can provide the optical performance to allow the use of these signals on a flexible meshed network of continental dimensions. CMOS electronics has enabled the digital signal processing (DSP) and error correction (FEC) necessary for practical coherent transceivers.

This course will introduce DSP-assisted digital coherent optical transmission. This includes electric field modulation, coherent detection, linear filtering, and data recovery. Single and multicarrier implementations will be examined. The dependence of the performance upon the dispersion map and upon the composition of the wavelength division multiplexed (WDM) spectrum will be addressed.

Benefits:

This course should enable you to:

- Understand basic implementations of electric field modulators.
- Understand basic implementation of coherent detectors.
- List or describe the main linear equalization function performed by DSP.
- Compare architectures of single and multicarrier coherent transceivers.
- Anticipate relative performances of coherent phase modulated channels vs. dispersion map and WDM channel spectrum.

Audience:

This course is intended for network operators, system integrators, and other interested parties seeking introductory insight into DSP-assisted coherent optical transmission.

Instructor Biography:

Before joining Ciena, Maurice O'Sullivan worked at Nortel for a score of years, at first in the optical cable business, developing factory-tailored metrology for optical fiber, but mainly in the optical transmission business, developing, modeling, and verifying physical layer designs and performance of Nortel's line and highest rate transmission product including the first commercial 10 Gb/s system, several commercial terrestrial line systems, the first commercial DSP assisted electric field modulation transceiver with complete electronic compensation for optical dispersion, and the first commercial coherent 40Gb/s and 100Gb/s transceivers. Many of these products remain as part of the Ciena product catalog. He continues on this path and is at present contributing to the design of Ciena's next coherent product. He holds a Ph.D. in physics (high resolution spectroscopy) from the University of Toronto and has more than 20 patents.

SC101 Hands-on Workshop on Fiber Optic Measurements and Component Testing

Monday, March 7, 2011
8:30 AM - 12:30 PM

Instructor: *Caroline Connolly[1], Chris Heisler[1], Richard Buerli[1], Joseph Bos[2], Michelle Collier[3], [1]OptoTest Corp., USA, [2]Luna Technologies, USA, [3]AFL Telecommunications, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This Short Course focuses on the practical aspects of working with fiber optic components and instrumentation used to make optical performance characterization measurements. Four fully equipped stations are available for hands-on participation.

Rotation 1) Basic Component Testing—test and measurement techniques and latest issues involving single-mode and multimode fiber, cable and connectors including insertion loss, return loss, and visual fault location.

Rotation 2) Launch condition effects on multimode fibers. Launch conditions will be demonstrated and measured via near field, far field, and encircled flux methods. Includes demonstration and hands-on measurements with launch condition analyzer.

Rotation 3) Optical Time Domain Reflectometer (OTDR) and Fiber Link Characterization—understanding the measurements involved in characterizing a fiber link for high speed communications. Includes a demonstration of an OTDR for testing and troubleshooting of networks. By analyzing the backscatter and link length, attenuation and reflections can be analyzed. Anomalies such as connectors, splices, and breaks can be evaluated. As speeds increase, measurements such as Chromatic and Polarization-Mode Dispersion become necessary.

Rotation 4) Component test and characterization measurements such as CD, PMD, GD, Jones-Matrix Eigenvectors will be measured. Test instruments such as the optical vector analyzer,

tunable lasers, and optical power meters are used to measure PDL using the All-States-Method and the Mueller-Stokes-Method. Experiments will help participants visualize polarization-dependent behaviors of fiber optic components.

Industry trends will be related in each rotation such as encircled flux requirements, high density connectivity, phase related measurements important to the design and manufacture of optical components.

Benefits:

This course should enable you to:

- Explain the fundamental optical differences and applications of single-mode fiber (SMF) vs. multimode fiber (MMF), including the different fiber types and fiber sizes.
- Identify the different connector types and understand their specific performance features (i.e., E2000, FC, LC, Mil-Styles, MTP, SC, ST, etc.) plus the various end-face options (i.e. Expanded Beam, UPC and APC).
- Test connectors, cable assemblies, and fiber links for insertion loss (IL) and return loss (RL), while also understanding how these measurements can be affected by wavelength and launch conditions.
- Explain characterization measurements on passive optical components.
- Measure spectral performance attributes using an optical vector analyzer (OVA).
- Measure polarization-dependent loss (PDL) and polarization mode dispersion (PMD) of fiber optic components.
- Test and troubleshoot fiber links and component assemblies using OTDR techniques.
- Measure and understand performance parameters of passive optical network components.

Audience:

This course is valuable to technicians, engineers, and managers interested in measurement and characterization of fiber optic components. Some familiarity with fiber optic test cables and equipment is assumed. Class size is limited to 16.

Instructor Biography:

Caroline Connolly is a Sales Director at OptoTest Corp. and has been involved with fiber optic test and measurements technologies and cable assemblies for more than 12 years. Her experience covers all areas of physical layer optical testing ranging from laboratory to field applications. Before joining OptoTest, she worked in various key sales positions at Rifocs Corp. Connolly holds a bachelor's degree in business management from the University of Phoenix.

Richard Buerli is the President of OptoTest Corp. and has been involved in fiber optics test and measurement since 1984. His background encompasses the communications and telecommunications industries, including LAN instruments, fiber optics, fiber optic components,

and fiber optic test equipment. He previously served as vice president of new product development for Tempo Research, a test equipment supplier for some of the most respected companies in the datacom, telecom, and fiber optics market, where he assumed responsibility for RIFOCS engineering and product development and led an engineering team of 25 engineers and support staff. At Photodyne/3M Photodyne, Buerli was a senior product engineer for fiber optics products, specializing in optical time domain reflectometers (OTDRs). He holds a master's degree in computer sciences from the Institute for Technology (ETHZ), Zurich, Switzerland; a bachelor's degree in electrical engineering from HTL Winterthur, Switzerland; and a certification in management from the University of California at Santa Barbara. He is a member of IEEE, SPIE, and TIA, and has published articles in various trade magazines.

Chris Heisler has been in the fiber optics industry for over 4 years. For this duration he has worked at OptoTest Corp. as an Applications and Test Engineer where he has studied and researched fiber optic cable measurements with a focus on launch condition measurements and the various standards governing these measurements. Chris attended California Polytechnics San Luis Obispo where he received a B.S. in electrical engineering and is currently pursuing his master’s degree.

Dawn Gifford, Ph.D., is the Director of Technology Development for Luna Technologies. Since 2002, Dr. Gifford leads a team responsible for research and development of fiber optic measurement and sensing technology and instrumentation. She helped develop Luna’s fiber optic test and measurement instrumentation. Dr. Gifford received her doctorate in optics at the Institute of Optics, University of Rochester, and her bachelor’s degree in physics from Brigham Young University.

SC160 Microwave Photonics

Monday, March 7, 2011
8:30 AM - 12:30 PM

Instructor: *Keith Williams; NRL, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

There has been significant progress in photonic components and technology applicable to microwave (analog) systems; several unique microwave functions have been implemented in the photonic domain. Along with or because of these technical advancements, there has been expanding acceptance of photonics for microwave systems. This updated and revised Short Course will review some of the current capabilities and limitations of photonics as divided into four areas. They are: techniques and devices for generating microwave-modulated light, techniques and devices for detection, RF transmission links (distinguished from digital transmission systems), and microwave signal processing (including time-delay beamforming,

downconverting, filtering, microwave circuit control and photonic analog-to-digital conversion). Emphasis will be placed on relating device operation to basic photonic subsystem performance and relating the photonic link and functions to comparable microwave techniques (e.g., link loss, noise figure, dynamic range and phase error). More recent technology advancements will also be incorporated.

Benefits:

This course should enable you to:

- Explain limitations of photonics for microwave systems.
- Identify promising technologies for analog system improvements.
- Discuss and relate analog and digital fiber optic system differences.
- Design optical systems for microwave applications.

Audience:

The course attendee should have a basic understanding of lasers, photodetectors, and/or fiber optics. A bachelor's degree in engineering or the physical sciences or an equivalent level of experience is necessary to understand the system and design aspects of the course.

Instructor Biography:

Keith J. Williams received his B.S.E.E. degree from the University of Nebraska and M.S. and Ph.D. degrees from the University of Maryland. His doctoral research was conducted on microwave p-i-n photodetector nonlinearities. He is presently the head of the photonics technology branch of the Naval Research Lab, Washington, D.C., where his research interests include microwave-optical devices, microwave fiber-optic links and systems and high current photodiodes.

SC264 Introduction to Ethernet Technologies

Monday, March 7, 2011
8:30 AM - 4:00 PM

Instructor: *Jeffrey Cox; BT, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course will begin by covering the history of Ethernet in the IEEE 802.3 standards and its evolution through present-day implementations. All major commercially successful variants will be reviewed at the physical layer, including coax (thin and thick-wire), twisted-pair, fiber (multi and single-mode), 10Mb, 100Mb, Gigabit, and 10G. Discussion topics will include media, topologies, framing, coding, and media access control. The material will then introduce the data-link layer by covering learning bridges, spanning-tree, VLANs, trunking, and flow control. This information will be leveraged to illustrate how larger "switched" Ethernet networks are sometimes built. Issues related to scaling switched networks and "when to route" will be addressed ("Layer 2" vs. "Layer 3" networks). Extending Ethernet beyond the LAN into metropolitan and long haul networks will be explored. Different transport, protection, and restoration mechanisms will be examined including Ethernet over SONET, GFP, DWDM, and "native" transport. Finally, we will cover techniques for building extremely large-scale Ethernet-based networks that integrate Layer 2 switching, Layer 3 routing, and optical transport.

Benefits:

This course should enable you to:

- Define Ethernet's place in the IEEE 802 standards.
- Identify the various Ethernet frame types.
- Explain how Learning Bridges function including the Spanning Tree protocol.
- Describe VLANs, trunking, and flow control.
- Describe Ethernet's various physical-layer implementations.
- Describe the various options for transporting Ethernet beyond the LAN environment.
- Discuss issues relating to protection and restoration in Ethernet environments.

Audience:

The audience may include optical networking and optoelectronic technology researchers with an interest in quantum communications, managers of research groups, and engineers who want a glimpse of a new and forward-looking technology. An undergraduate-level understanding of quantum mechanics is helpful.

Instructor Biography:

Jeffrey L. Cox has accumulated more than 25 years of experience in designing, deploying, and supporting large-scale enterprise and carrier data networks. From 1985 to 1992, he designed and supported a large multi-protocol network infrastructure at Texas A&M University. During the mid 1990s, he built enterprise networks for various large corporations including Texas Instruments. He joined Level 3 Communications in 1998 and was responsible for the global architecture of the company's MPLS backbone and other packet infrastructures. In 2000, he started Celion Networks, building optical DWDM transport equipment targeted at transporting enterprise data traffic. He currently works at BT as Director of Research & Technology - Networks.

SC208 Optical Fiber Design for Telecommunications and Specialty Applications

Monday, March 7, 2011
9:00 AM - 12:00 PM

Instructor: *David J. DiGiovanni; OFS Labs, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Optical fiber design remains a robust field for innovation in both telecom and nontelecom applications. As worldwide bandwidth demand continues to grow, new fiber types and fiber-based components can increase speed, reduce cost, and improve the bandwidth of communications networks. In addition, application-specific fiber can enable or benefit a wide array of functions such as simply transporting light between two points, amplifying light, processing signals, sensing environmental characteristics, and even transporting particles. The tools available in adapting fiber to particular uses, whether for high-speed communications or other applications, include a range of materials and dopants (glasses, polymers), the mechanics of the fiber (size, coatings, microstructure), waveguiding properties (index profile), and various fiber-based devices such as gratings and amplifiers. These tools have been used to establish an industry that continues to expand as photonics penetrates more and more industries and applications.

This short course will discuss the many ways in which optical fiber design can be used in a wide range of applications and will review an array of current fiber technologies. We will consider the role and capabilities of materials, structures, and waveguide design for both fiber and fiber-based photonic components. The focus will be on understanding the capabilities of fiber design and engineering with the goal of demonstrating the many opportunities available with novel optical fibers. Specific attention will be on the impact of transmission fiber design and properties for high-speed optical communication such as >40Gb/s transmission and coherent detection; designs for optical amplification and dispersion compensation; and the design of waveguides to produce effects such as enhanced nonlinearity and bandgap operation.

Benefits:

This course should enable you to:

- Understand how certain fiber attributes, such as attenuation, modal area, and dispersion, can impact current and next-generation high-speed communications technologies.
- Describe the wide array of optical fibers available and discuss how their designs have been engineered for particular applications.
- Compare the benefits of different materials in fiber design, including different glass dopants.

- Design simple fibers for various applications, such as amplifiers, dispersion compensators, sensors and component pigtails.
- Determine whether particular applications can benefit from modified or novel optical fiber.
- Understand the potential offered by fiber engineering which may be exploited to improve existing applications or create new functions.

Audience:

This course is intended for the technical community seeking to understand the potential of optical fiber and waveguide design. Basic understanding of optical fiber properties is desirable though not required.

Instructor Biography:

D. J. DiGiovanni received several engineering and mathematics degrees from Brown University, including a Ph.D. in 1987. He joined Bell Laboratories in the Optical Fiber Research Department in 1990 and has worked on various phenomena related to optical fibers for erbium-doped amplifiers, high-power amplifiers and lasers, and Raman amplification. He has co-authored numerous journal articles and book chapters and has received more than 50 patents for his work. He is now Director of OFS Laboratories and continues to explore designs and applications of novel fibers.

SC261 ROADM Technologies and Network Applications

Monday, March 7, 2011
9:00 AM - 12:00 PM

Instructor: *Thomas Strasser; Nistica Inc., USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

In the past few years, one of the most promising new optical technologies has been the Reconfigurable Optical Add-Drop Multiplexer (ROADM). This technology is in the process of transforming worldwide metropolitan transport systems to a more automated and scalable network. Evidence of the commercial traction is seen in requests for proposals (RFPs) from the largest North American carriers, more than a dozen RFPs from service providers worldwide, and deployment of more than $100 million of ROADM technology in 2004. This represents a groundbreaking commercial technology transformation of transparent optical routing displacing electrical grooming equipment for the first time on such a wide scale. Despite the commercial success, substantial confusion has surrounded this technology. This is largely because (a) the

ROADM market is poorly defined since it may mean a subsystem or a system, neither of which have market-accepted minimum functionalities; and (b) the lack of a clear market definition has been exploited to promote competing technologies driven by different commercial interests. This course will give a historical perspective of how this technology evolved, the numerous network benefits derived, and how those benefits depend on the functionality of the technology employed. Finally, the course will describe how these technologies are being integrated into WDM systems and what types of networks most fully leverage the new capabilities to provide network value.

Benefits:

This course should enable you to:

- Describe the network level benefits of ROADM systems.
- Define the different ROADM technology approaches competing in the market.
- Summarize the functionality differences between competing ROADM technologies, including which are most likely to succeed in the long term and why.
- Compare the incremental cost of a ROADM to the network level savings it enables.
- Discuss the types of networks that most fully benefit from ROADM technology and why.
- Explain the contradictory statements made about ROADM in trade literature.

Audience:

Anyone interested in more fully understanding the functionalities and benefits of ROADMs, including students, researchers, engineers, managers, and executives involved in ROADM development, network design, network planning, and network operations.

Instructor Biography:

Thomas A. Strasser received a doctorate from Cornell University designing periodic guided-wave devices and worked for three years at Eastman Kodak Research Labs and seven years at Bell Labs in Murray Hill, New Jersey. At Bell Labs his group invented and developed manufacturing for enabling technologies in the next-generation transmission platforms of AT&T and Lucent Technologies. He served for five years as the chief technologist defining the ROADM-based platform of Photuris and its subsequent acquirer, Mahi Networks. He is currently CTO of an early-stage startup, Nistica Inc., focusing on next-generation optical technologies. Strasser was the OFC/NFOEC 2006 General Co-chair and the OFC 2004 Technical Program Co-chair. He has contributed 40 patents and more than 100 presentations and publications in the field of optics and communication devices.

SC141 Combating and Monitoring Data-Degrading Effects in Non-Static WDM Systems

Monday, March 7, 2011
9:00 AM - 12:00 PM

Instructor: *Alan Willner; Univ. of Southern California, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

To avoid data degradation, high-data-rate WDM systems might be required to monitor and dynamically adapt to changing environmental and traffic conditions. This scenario erupts into a much greater challenge when channels can dynamically originate from different locations, as is the case with reconfigurable add/drop multiplexers and cross-connects. It may also be critical for the network to continuously monitor the health of the data channels at many locations, such that any linear or nonlinear degrading effect can be isolated, diagnosed, and repaired. Overarching concerns in this Short Course include: (i) understanding the non-static and dynamic nature of many data-degrading effects so that the network can be designed properly for long-term operation, (ii) describing several techniques for real-time optical performance monitoring of the data channel for any degradations, and (iii) exploring methods in which the network can take action to mitigate, compensate, or avoid the problems. The intended audience is those interested in becoming familiar with dynamic channel-degrading effects, various optical-performance-monitoring schemes, and possible practical solutions. Monitoring and compensation of greater than 40-Gbit/s channels will be highlighted for the following effects: chromatic dispersion, nonlinear effects, OSNR, non-ideal EDFAs, polarization mode dispersion, WDM channel power equalization, and intra-channel cross talk. Various data modulation formats, such as OOK and DQPSK, will be treated.

Benefits:

This course should enable you to:

- Summarize the non-static and dynamic nature of many data-degrading effects in a fiber network.
- Describe several techniques for real-time optical performance monitoring of a degraded data channel.
- Compute a simple optical power budget.
- Identify the components best suited for a given optical interconnect application.
- Explain short-reach optical interconnect technology to system engineers and management.

Audience:

This introductory course is intended for an audience with at least some technical background in engineering, physics, or related disciplines, and is ideally suited for engineers from related fields in optics, electronics, networking, or computing systems who want to learn more about short-reach optical interconnects. Marketing or business development professionals seeking a deeper understanding of the technology may also consider taking this course.

Instructor Biography:

Alan Willner (Ph.D., Columbia) worked at AT&T Bell Labs and Bellcore and is a Professor of Electrical Engineering at the University of Southern California. He received the NSF Presidential Faculty Fellows Award from the White House, Packard Foundation Fellowship, NSF Young Investigator Award, Fulbright Foundation Senior Scholars Award, USC University-Wide Outstanding Teacher Award, Eddy Best Technical Paper Award from Pennwell, and Columbia's Armstrong Memorial Prize. He is an IEEE Fellow, OSA Fellow, and LEOS Distinguished Lecturer, He was president of IEEE LEOS, OSA Science and Engineering Council Co-Chair, *Optics Letters* Editor-in-Chief, *Journal of Lightwave Technology* Editor-in-Chief, *IEEE JSTQE* Editor-in-Chief, CLEO General Co-chair, OSA Photonics Division Chair, and OFC steering/program committee member.

SC358 Data Center Cabling—Transitioning from Copper to Fiber

New Course!

Monday, March 7, 2011
9:00 AM - 12:00 PM

Instructor: *Lisa A. Huff[1,2]; [1]DataCenterStocks.com, USA, [2]Discerning Analytics, LLC, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

This short course is intended to help data center and network managers understand the value proposition of an all-optical data center. Topics that will be discussed include looking at basic data center network infrastructure design and hardware needs. The course was developed with the TIA-942, Telecommunications Infrastructure Standard for Data Centers in mind, but will also address the fact that many data centers really have not used this standard in practice. Networking standards such as IEEE 802.3, Fiber Channel, iSCSI, and InfinBand will be reviewed along with their applicability to certain aspects of the data center. Technology roadmaps and data center networking trends will be included as well as how to handle transitioning from lower to higher data rates within a data center. When it makes sense to implement fiber optics and what types of transceivers and cabling should be used for different scenarios will be presented. Other technologies such as fiber channel over Ethernet, RDMA (InfiniBand) over converged Ethernet,

IO virtualization, and how virtualization and network consolidation will affect data rates will also be discussed. Detailed cost analysis of fiber versus copper in the data center will be presented, considering not only equipment and infrastructure cost, but potential staff, port and cabling density, power, and cooling costs. Also included will be analysis of whether it matters what vertical market a data center supports—for example, does a financial sector data center have different requirements than a higher-education data center? Several real-world case studies will be presented.

Benefits:

This course should enable you to:

- Design data center networks in accordance with TIA-942.
- Determine when a fiber-optic cabling solution would be appropriate.
- Define Ethernet, fiber channel, and InfiniBand technologies and their appropriate applications.
- Compute how cost effective your current network topology is.
- Determine appropriate measures for upgrading network equipment to higher data rates.
- Accurately and realistically compare copper and fiber technologies in the data center.
- Identify different defined areas of a data center.
- Determine appropriate technologies for your data center.

Audience:

This course is valuable to engineers, technicians, networking professionals, and managers interested in transitioning their networks and data centers from copper to fiber optics. Data center operators and facilities managers may also be interested in attending to understand some of the networking technologies contained in their data centers.

Instructor Biography:

Lisa A. Huff is Chief Technology Analyst for DataCenterStocks.com and principal analyst for Discerning Analytics, LLC. She is a Certified Data Center Professional (CDCP) and degreed electrical engineer with more than 25 years experience in the electronics industry. Her recent works include several market research reports on optical interconnects, structured cabling, passive optical LAN, and 40/100G markets. She contributes to two ongoing blogs on DataCenterStocks.com and Optical Components and is a contributory writer for DataCenterStocks.com Data Center Network Operator service.

SC187 Hands-on Basic Fiber Optics for the Absolute Beginners

Monday, March 7, 2011
1:00 PM - 5:30 PM

Instructor: *Dennis Horwitz; Micronor Inc., USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This Short Course provides a very practical introduction to fiber optics with extensive show-and-tell and hands-on experiments to help better understand the concepts and industry trends by both seeing and doing. It has proven a popular and useful course to not just engineers but also purchasing, manufacturing, program management, sales, marketing, and management. The course provides a practical overview to the essential concepts behind fiber optics, including: single-mode, multi-mode, core, cladding, numerical aperture, attenuation, dB, dBm, dispersion, bandwidth, SONET, DWDM, and GbE. We also will discuss the broad range of applications from commercial telecommunications to military and aerospace, from medical to geophysical, and more. Mixed in with the various topics are hands-on test and measurement experiments to help better understand fiber optics and its nuances: visual fault location, optical power, attenuation, insertion loss, return loss, and optical time-domain reflectometry. The hands-on experiments help to introduce the participant to popular fiber optic standards used throughout various industries, including TIA fiber optic test procedures (FOTPs) and optical fiber system test procedures (OFSTPs). The participant will also come to understand some of the many variations in testing, the meaning of the results, and important tips when working with fiber.

Benefits:

This course should enable you to:

- Explain the fundamental optical differences and applications of single-mode fiber (SMF) vs. multimode fiber (MMF), including the different fiber types and fiber sizes.
- Identify the different connector types and understand their specific performance features (e.g. E2000, FC, LC, MIL styles, MTP, SC, ST, etc.) plus the various end-face options (i.e., Expanded Beam, NC, PC, SPC, UPC, and APC).
- Test connectors and cable assemblies for insertion loss (IL) and return loss (RL).
- Measure attenuation differences and bend loss effects in single-mode and multi-mode fiber links.
- Explain the differences between standard OTDRs and high resolution, short haul OTDRs, as well as their applications.
- Apply proper handling and cleaning techniques.
- Explain DWDM concepts and trends in telecommunications as well as Gigabit Ethernet technology driving LAN/WAN applications.
- Explain limitations of COTS components vs. requirements of harsh/hazardous environments.

Audience:

The course is the ideal introduction to fiber optics and is geared toward the engineer or manager just making the transition into fiber optic technology. Every two participants will share a test and troubleshooting set consisting of a visual fault locator (VFL), optical power meter (OPM), LED source, laser source, connector cleaning tools, and a variety of test cables to simulate different test scenarios.

Instructor Biography:

Dennis Horwitz received his M.S.E.E. from the University of California at Los Angles and has more than 30 years experience in research and development, product development, sales, and marketing of fiber optic test equipment and components. He was co-founder of two successful start-ups in fiber optic test and measurement: Photodyne Inc. (1979–1990, sold to 3M) and Rifocs Corp. (1990–2003, sold to Textron). He is actively involved in fiber optic standards development (ARINC, ISA, SAE, and TIA) and has been an OFC/NFOEC Short Course instructor for more than 10 years. He is currently Vice President for Sales/Marketing for Micronor Inc., which has developed and commercialized the first totally passive fiber optic rotary encoder for motion control applications.

SC175 Packaging of Optoelectronic, Photonic and MEMS Components

Monday, March 7, 2011
1:30 PM - 4:30 PM

Instructor: *Tolga Tekin1,²; ¹Technische Univ. Berlin, Germany, ²Fraunhofer-Inst. für Zuverlaessigkeit und Mikrointegration (IZM) System Integration and Interconnection Technologies, Germany*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This Short Course provides an overview of the challenges, current solutions, and future trends in the development of practical photonic, optoelectronic, and MEMS component packaging. The course will cover those aspects of optics, device physics, and materials science required to understand valid packaging solutions and also to participate in the engineering of these solutions. The current art in packaging of optoelectronic components will be discussed, and examples of innovative packaging solutions that are beginning to be applied will be presented.

Benefits:

This course should enable you to:

- Determine the critical issues involved in photonic package development and their impact on manufacturing costs and component performance.
- Appreciate how optical design of components influences packaging.
- Identify the various materials selection alternatives for photonic packaging.
- Describe important elements of mechanical design for successful packaging of photonic, optoelectronic, and MEMS devices.
- Identify the important electronic design issues operable in optoelectronic component packaging.
- Discuss intelligently the details and tradeoffs involved in package design and assembly.
- Explain the advantages and disadvantages of evolving solutions for optoelectronic and photonic component packaging.
- Establish design strategies and work effectively toward practical and reliable solutions to challenges in photonic, optoelectronick and MEMS packaging.

Audience:

This course will be useful for engineers who want to broaden their understanding of packaging technology management or wish to understand the issues involved in photonic component packaging development. Entrepreneurs and venture promoters looking to find the best packaging solution for their needs will also find the course useful.

Instructor Biography:

Tolga Tekin received his B.S. degree in electronics and telecommunications engineering from Istanbul Technical University in 1992, his M.S. degree in electrical engineering from Technical University of Berlin in 1997, and his Ph.D. degree in electrical engineering and computer science at Technical University of Berlin in 2004. He worked as research scientist at Fraunhofer-Institut for Telecommunications Heinrich-Hertz-Institut where he focused on optical signal processing, 3R regeneration, all-optical switching, clock recovery, and integrated optics. He worked as a postdoctoral researcher at University of California on components for OCDMA and Terabit router. He worked at Teles on phased array antennas for skyDSL. He is now with Fraunhofer-Institut for Reliability and Microintegration, leading projects on optical interconnections and silicon photonics packaging.

SC205 Integrated Electronic Circuits and Signal Processing for Fiber Optics

Monday, March 7, 2011
1:30 PM - 4:30 PM

Instructor: *Y. K. Chen, Noriaki Kaneda; Bell Labs, Alcatel Lucent, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

High speed electronics at 10, 40, and 100 Gbit/s is a critical enabler for fiber-optic networks. We will review the basic functions of high-speed lightwave circuits in optical terminals, with emphasis on physical layer interface electronics. The basic functions and architecture of these circuits will be reviewed. The high-speed IC technologies and their implementation of these important high bit-rate digital and analog applications—such as receiver front-ends, clock-data recovery circuits, TDM multiplexers, de-multiplexers, and transmitter functions—are presented. Methods to enhance the performance and bandwidth are illustrated with examples from literature, along with results showing the current state of the art. Finally, the potential of using low-cost electronics to process emerging spectral efficient signaling format and to equalize and mitigate optic fiber transmission impairments will be illustrated.

Benefits:

This course should enable you to:

- Describe the functions and performance of high-speed electronics for optic fiber terminals.
- Evaluate the design and implementation of physical layer electronic circuits.
- Describe commonly used circuit architectures.
- Compare the merits among different IC technologies.
- Justify advanced electronic equalization techniques.

Audience:

This course is intended for engineers, scientists, or managers who must make or understand the choice of electronic circuits for optical transmission products or evaluate electronic solutions used in purchased products.

Instructor Biography:

Young-Kai Chen is a Director of the high speed electronics and optoelectronics research department at Bell Labs, Alcatel-Lucent. He received his doctorate in electrical engineering from Cornell University. He worked for General Electric Co. before joining Bell Labs. He is a Fellow of IEEE, a member of the National Academy of Engineering, and a recipient of the IEEE David Sarnoff Award. He has published three book chapters, more than 100 journal papers, and more than 150 conference papers, and he has received 15 patents.

Noriaki Kaneda is member of technical staff at Bell laboratories, Alcatel-Lucent, Murray Hill, New Jersey. His Ph.D. academic work included microwave photonics at the University of California at Los Angeles. Since he joined Lucent Technologies in 2000, he has worked on various topics regarding optical data formats including direct detection DPSK, digital coherent

QPSK, and coherent optical OFDM for the high bit rate optical transmission systems. His current research interest consists of high-speed digital signal processing in optical transmission systems.

SC266 Quantum Cryptography and Quantum Information

Monday, March 7, 2011
1:30 PM - 4:30 PM

Instructor: *Richard Hughes[1], Thomas Chapuran[2]; [1]Los Alamos Natl. Lab, USA, [2]Telcordia, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course will describe the new and rapidly expanding field of quantum communications, which promises to revolutionize some aspects of communication networks. It will provide a view of an early application of quantum information and quantum communications, namely quantum cryptography and why it may be of interest for the OFC/NFOEC community. After a brief motivation as to "what is cryptography" and "What are the limitations with conventional cryptography," the course will provide a high-level view of quantum cryptography and quantum key distribution. The course will provide a brief history of quantum cryptography from its inception to the present time and will walk through detailed examples of how the BB-84 QKD protocol works. The course will then turn to the realities of real-world light sources and photon detectors. The course will include both fiber and free space environments and will identify and summarize some of the major efforts worldwide in this area. Finally the course will introduce the EPR paradox and quantum entanglement and teleportation, and will briefly describe how the single-qubit systems used in QKD set the stage for multi-qubit quantum information systems for the future.

Benefits:

This course should enable you to:

- Identify benefits of quantum key distribution techniques.
- Determine free-space and fiber based applications.
- Describe single photon sources and compute their expected characteristics.
- Describe concepts of quantum entanglement.
- Determine appropriate networking applications for quantum communications.
- Describe quantum teleportation.

Audience:

The audience may include optical networking and optoelectronic technology researchers with an interest in quantum communications, managers of research groups, and engineers who want a glimpse of a new and forward-looking technology. An undergraduate-level understanding of quantum mechanics is helpful.

Instructor Biography:

Richard J. Hughes is a laboratory fellow at the Los Alamos National Lab. He is co-principal investigator of projects in both free-space and optical fiber based quantum key distribution and holds two US patents in these areas. He obtained his doctorate from the University of Liverpool and has held positions at Oxford University, Queens College Oxford, Caltech, CERN, and the University of Oslo. His awards include the Los Alamos Distinguished Performance Award, Los Alamos Fellow's Prize, co-winner of an R&D Development 100 Award for "Free Space Quantum Cryptography," and co-winner of the European Union's Descartes Prize. He is an APS Fellow and has authored more than 120 scientific papers.

Thomas Chapuran is a Senior Research Scientist at Telcordia. He is co-principal investigator of a project on quantum key distribution in reconfigurable multi-wavelength optical networks. He holds a doctorate in experimental nuclear physics from the University of Illinois and served on the faculty at the University of Pennsylvania. His research includes optical network architectures, broadband access, and signaling and control for next-generation networks. He received Telcordia CEO Awards in 2000 and 2001 and has authored numerous papers in the fields of telecommunications and physics.

SC289 Basics of Optical Communication Systems and WDM

Monday, March 7, 2011
1:30 PM - 4:30 PM

Instructor: *Gerd Keiser[1,2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

The course covers the functions and operational characteristics of available optical fibers, transceivers, and specialized passive and active components needed for designing modern optical fiber communication links. It explains distortion effects on lightwave signals, defines bit error rate and receiver sensitivity, and identifies measurement equipment and procedures used to verify system operating characteristics. The course also defines wavelength division multiplexing (WDM) concepts, components, and applications. The topics include characteristics

of wavelength multiplexers, optical amplifier uses in WDM links, WDM link design examples, and implementation of WDM-based metro and FTTP networks.

Benefits:

This course should enable you to:

- Describe the functions and operations of key components in fiber optic links.
- Summarize technology trade-offs for implementing different types of fiber optic systems.
- Compare different component types for optical fiber link designs.
- Explain signal distortion effects due to dispersion and nonlinear processes.
- Discuss wavelength division multiplexing (WDM) concepts and components.
- Describe WDM applications to long-haul, metro and FTTP networks.
- Identify measurement equipment and define test procedures.

Audience:

This course is intended for engineers who are new entrants to the fiber optic communications field, component and product design and test engineers, technical trainers, technical sales and marketing personnel, consultants, telecommunications managers, and anyone who needs an introductory knowledge of optical fiber communications.

Instructor Biography:

Gerd Keiser was involved with telecommunication technologies at Honeywell, GTE, General Dynamics, and PhotonicsComm Solutions. He is a consultant in the telecommunications industry and was an adjunct professor of electrical engineering at Northeastern University, Tufts University, and Boston University. Currently he is a National Science Council Chair Professor at the National Taiwan University of Science and Technology. He is an IEEE Fellow, a member of OSA and SPIE, an Associate Editor of Optical Fiber Technology, and the author of four books. His professional experience and research interests are in the general areas of optical networking technology and biophotonics.

SC176 Metro Network: The Transition to Ethernet

Monday, March 7, 2011
1:30 PM - 4:30 PM

Instructor: *Loudon Blair; Ciena Corp., USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Metro networks are being stretched by new broadband services that are forcing the capacity of customer access links to increase by two to three orders of magnitude. Because service revenues are not growing in proportion to bandwidth, new network solutions are needed to dramatically lower the cost per unit bandwidth of the network infrastructure. Consequently, service providers almost universally are migrating from SONET/SDH to Ethernet for both equipment interfaces and the creation of a new packet transport layer. In this course, we explain the motivation for new service offerings for both residential and business environments and we analyze how these new services are changing the magnitude and pattern of traffic flows across the metro area. We then explore traffic projections at several key points in the metro network and estimate the required capacity of networking switches and transmission systems that will result from different service-mix scenarios. We will examine the mix of networking technologies that can be employed in the metro to yield a highly functional yet economic network solution. This will include an introduction to Carrier Ethernet and different implementation approaches to achieving carrier-grade performance as well as how Carrier Ethernet will operate in conjunction with other key network technologies including IP, OTN, and DWDM. With the anticipated dramatic growth in network capacity, the optical networking layer will play an increasingly important role in the metro network, both in enabling capacity scaling and in network reconfiguration. We discuss how the convergence of Carrier Ethernet and optical technologies is leading to the development of new Packet Optical Transport Systems (POTS). Applications of how POTS may be used in metro networks are explored using use cases.

Benefits:

This course should enable you to:

- Describe how new services are changing metro network traffic characteristics.
- Describe the impact that these new services will have on metro network traffic patterns and network equipment capacity in both aggregation and core metro networks.
- Describe the meaning of Carrier Ethernet and discuss different implementation approaches.
- Describe the key networking technologies used to build next generation metro networks, including DWDM, OTN, and IP/MPLS.
- Discuss the role of Carrier Ethernet in new metro architectures and how it operates in combination with other key technologies.
- Describe how packet and optical technologies are converging to form Packet Optical Transport Systems (POTS).
- Discuss how POTS may be used in different metro application scenarios.

Audience:

This course is intended for network architects and planners from service providers, engineering and marketing staff to network equipment providers, technologists with an interest in the evolution of networks, industry analysts, and financial analysts.

Instructor Biography:

Loudon Blair is a Principal Network Architect at Ciena. Since joining the company in 1997, he has performed several roles in the development of Ciena's optical networking products. He has also worked at Iridium, BT, and Hitachi. He has been a long-term contributor to OFC and was General Co-chair for OFC/NFOEC in 2008.

SC185 Hands-on Polishing, Inspection and Testing of Connectors

Monday, March 7, 2011
1:30 PM - 5:30 PM

Instructor: *Cameron Karch[1], Steve Baldo[2], Neal Wagman[3]; [1]Light Brigade Inc., USA, [2]Seikoh Giken Co. Ltd., USA, [3]Norland Products, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

This course consists of three stand-alone segments that are supervised by fiber-optic experts specializing in each particular discipline. Each segment includes both knowledge and skill (hands-on) components. The first segment, fiber-optic polishing, focuses on mass-production termination techniques that work with fiber optic connectors including SC and LC connector types with UPC and APC polishes. Learn how to achieve low insertion loss, low reflectance, optimum end-face geometry, and improved production yields. The second segment, fiber-optic end-face inspection, explains the principles of microscopy and interferometry as they relate to the inspection and testing of fiber-optic plugs and termini. Hands-on demonstration will show how microscopes and interferometers help to control the polishing process by checking for scratches and measuring end-face geometry. The third segment, connectorization testing, reviews the test equipment used for attenuation and reflection testing after the polishing process is complete. The assemblies manufactured in the course are used in the testing to allow the course attendee to follow the production from assembly through testing processes.

Benefits:

This course should enable you to:

- Measure and understand optical attenuation measurements and expected variations at 1310/1550/1625nm.
- Measure optical return loss and define its relationship to connector polishes, polishing procedures and test methods.

- Identify contaminants, their cause, and how to resolve contamination issues with a variety of cleaning products.
- Identify and discuss the fundamentals of the polishing processes and their impact on attenuation and reflection.
- Identify and determine how to adjust variables that affect end-face geometry.
- Measure scratches using automatic analysis equipment.
- Apply the criteria for pass/fail in quality assurance programs and applications.
- Determine how the immediate feedback from the interferometer will help control the manufacturing process, creating higher performance terminations and increased production yields.

Audience:

This course is applicable to those involved with fiber optic terminations from the novice to production engineers and managers involved with laboratory, manufacturing and field disciplines. A basic knowledge of fiber optics is expected.

Instructor Biography:

Since 1987, The Light Brigade (TLB) has instructed more than 35,000 attendees in its classes on fiber optic design, maintenance and testing, including topics such as OSP, networking, FTTx, DWDM and PMD/CD. Since 1990 TLB has provided a variety of special events at the OFC/NFOEC and CLEO conferences.

Norland Products Inc. has been manufacturing novel products to meet critical customer needs for more than 40 years. One of its specialties is 3-D interferometric testing and inspection of fiber-optic connectors. As the leader in this area, it has been actively involved in providing the optimum methods to achieve higher quality and cost savings.

Seikoh Giken (SG) provides high performance interconnectivity solutions for network systems and chip level applications. For networks and testing, Seikoh Giken provides premium patchcords (SMF and PMF), adaptors and attenuators. For manufacturers, SG manufactures ferrules, tunable connectors, polishing equipment, and films and photonic packaging technologies.

SC210 Hands-on Polarization-Related Measurements Workshop

Monday, March 7, 2011
1:30 PM - 5:30 PM

Instructor: *Daniel Peterson[1], Tasshi Dennis[2], Brian Teipen[3], Christine Tremblay[4]; [1]Verizon Business, USA, [2]NIST, USA, [3]ADVA Optical Networking, Germany, [4]École de Technologie Supérieure, Univ. du Québec, Canada*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

In this Short Course you will measure all of the polarization-related parameters that are important to high-speed fiber optic communications. The course begins with a brief review of key polarization concepts and a short description of the course equipment and setups. The participants then divide into small groups and rotate among four lab stations. In Lab 1, you will control and measure the state and degree of polarization. You will also measure polarization cross-talk on polarization-maintaining fiber and create a polarization reference frame for absolute polarization measurements. Equipment for this lab includes a polarimeter, a DOP meter, various polarization controllers, and a polarization extinction ratio meter. Tasshi Dennis is the instructor. In Lab 2, you will measure the polarization dependent loss (PDL) of optical components (including filters) using the all-states and Mueller matrix PDL methods. You will also measure and correct for the polarization dependence of optical power meters and OSAs. Equipment for this lab includes a swept Mueller matrix setup, polarization controllers and scramblers, a PDL meter, an OSA and an optical power meter. Christine Tremblay is the instructor. In Lab 3, you will measure the polarization mode dispersion (PMD) of transmission paths with combinations of high-PMD fibers. The measurement methods used in this lab include Interferometry and Jones Matrix Eigenanalysis (JME). Danny Peterson is the instructor. In Lab 4, participants will explore the impact of first- and second-order PMD on 40Gb/s NRZ digital waveforms and verify the technical difficulties associated with PMD compensation. Equipment for this lab includes a PMD source, low- and high-birefringence fibers, an optical oscilloscope, an optical transmitter and a polarimeter. Brian T. Teipen is the instructor.

Benefits:

This course should enable you to:

- Operate a wide variety of polarization-related test equipment.
- Measure polarization dependent loss (PDL) using all-states and Mueller methods and polarization-mode dispersion (PMD) using Interferometric and JME methods.
- Demonstrate the effect of PMD on high-speed digital signals and describe the technical difficulties associated with PMD compensation.
- Determine the outage probability in optical fiber transmission systems due to PMD-induced degradation.
- Measure polarization cross talk “in-line” and at the end of a PM fiber.
- Achieve optimum performance in polarization-maintaining (PM) fiber applications.
- Measure the polarization dependent response (PDR) of everyday test equipment and describe how to overcome PDRs by means of high-speed polarization scrambling.
- Describe the system-level effects of polarization-related impairments on long-haul optical transmission.

Audience:

This course is intended for engineers, technicians and managers involved with optical fiber, components or systems including those that operate at or above 10Gb/s.

Instructor Biography:

Daniel Peterson is a Distinguished Member of the Technical Staff at Verizon. He is an internal advisor on optical technologies for Verizon's ULH network. He received a Ph.D. in EE from the University of Texas. He is a senior member of IEEE.

Tasshi Dennis received the Ph.D. in electrical engineering from Rice University. He is a staff scientist at NIST in the Optoelectronics Division working on high speed optical measurements. He is an OSA member.

Brian T. Teipen, PhD, researches advanced optical transport techniques for ADVA AG Optical Networking in Meiningen, Germany. Brian received a Bachelor of Science degree in Physics at Indiana University in 1995, and a doctorate degree in Electrical Engineering at The University of Texas at Dallas in 2000. He is an IEEE and OSA member.

Christine Tremblay is a professor at the École de Technologie Supérieure, Université du Québec. She set up the Laboratoire de technologies de réseaux, a high-speed WDM physical layer test-bed, and established courses on optical communications and networking. Her current research includes the exploration of optical layer characterization techniques and novel optical network architectures. She also held senior R&D and technology management positions at Nortel, EXFO, and INO. She received a Ph.D. (optoelectronics) from the École Polytechnique de Montréal.

SC360 Hands-On Fiber Optic Terminations and Measurements with Emphasis on MTP Connectorized Ribbon Fiber

New Course!

Monday, March 7, 2011
1:30 PM - 5:30 PM

Instructor: *Caroline Connolly[1], Christopher Heisler[1], Richard Buerli[1], Loïc Cherel[2], Tony Nicholson[3], Mike Hughes[4], Brian Teague[4]; [1]OptoTest Corp., USA, [2]Data-Pixel SAS, France, [3]Connected Fibers, USA, [4]Conec Ltd., USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

In a practical, hands-on setting the student will learn about industry standard inspection, measurement, and qualification methods and will solidify the measurement concepts with hands-

on practice. With three fully equipped stations, we will discuss care and cleaning of fiber optic cable assemblies as well as the trends to high density connectivity and inspection. Students will use equipment during the class to measure insertion loss, return loss, and to measure and analyze interferometric results on simplex and multifiber connectors.

Students will learn the basic concepts of an interferometer and how these measurements are performed. A hands-on demonstration of making measurements on a single- and multifiber connector will be provided with reference to TIA and IEC standards. The main measurement parameters for fiber geometry will be discussed for single and multifiber terminations. The influence of each parameter on performance and long term reliability of the connector will be explained in detail.

Benefits:

This course should enable you to:

- Identify fiber types such as simplex, duplex, and ribbon fiber and their practical applications
- Classify connectors and components that are used in networks and other long haul applications.
- Use several cleaning methods and recognize contamination versus scratches using various inspection methods.
- Measure insertion loss and return loss on terminated cable assemblies for single-mode and multimode simplex and ribbon fibers.
- Measure and analyze geometric data using an interferometer for simplex and ribbon fibers comparing achieved and expected results.

Audience:

Those in positions from technicians and engineers to managers interested in connector trends and measurements will find this class valuable. Familiarity with fiber optic testing and equipment is beneficial but not necessary.

Instructor Biography:

Caroline Connolly is a Sales Director at OptoTest Corp. and has been involved with fiber optic test and measurements technologies and cable assemblies for more than 12 years. Her experience covers all areas of physical layer optical testing ranging from laboratory to field applications. Before joining OptoTest, she worked in various key sales positions at Rifocs Corp. Connolly holds a bachelor's degree in business management from the University of Phoenix.

Richard Buerli is the President of OptoTest Corp. and has been involved in fiber optics test and measurement since 1984. He previously served as Vice President of New Product Development for Rifocs Corp., a test equipment supplier for some of the most respected companies in the datacom, telecom, and fiber optics market. He holds a master's degree in computer sciences from the Institute for Technology (ETHZ), Zurich, Switzerland; a bachelor's degree in electrical

engineering from HTL Winterthur, Switzerland; and certification in advanced fiber optics from the University of California at Santa Barbara. He is a member of IEEE, TIA, and OSA and has published articles in various trade magazines.

Loïc Cherel is the CEO and founder of Data-Pixel SAS, a leading manufacturer of interferometry and inspection systems dedicated to the field of fiber optics. Mr. Cherel is a contributing expert to the IEC standardization organization (86B, WG4 & WG6). In particular, he is the editor of some of the IEC standards related to single and multifiber geometry measurements using interferometers.

Tony Nicholson is currently the Director of Technology at Connected Fibers, a company focused on selling manufacturing and test equipment, components, consumables, and tools for optical cable assembly fabrication. Since 1984, Mr. Nicholson has worked in various positions for companies manufacturing and developing test equipment primarily for the fiber optic industry. For the last 16 years he has been involved in the manufacture, sales, and support of interferometers for the fiber optic connector market and was on the technical advisory panel for the TIA during the draft of the first FOTP for measuring fiber optic connectors.

Mike Hughes is the Product Manager for multifiber connectivity products at US Conec Ltd. He has held engineering and commercial positions in MT ferrule technology for over 9 years and has over 17 years of experience in copper and fiber optic connectors and cabling products. Mike is a US National Committee contributing expert to IEC SC86B, WG4, and WG6. Mike holds a Bachelor of Science degree in mechanical engineering from North Carolina State University and a Master of Business Administration degree from Wake Forest University.

Brian Teague is the Product Manager at US Conec Ltd. for fiber optic connector cleaning tools. Brian has over 13 years of experience working with fiber optic connectors and cabling in telecommunications, enterprise, and harsh environment applications. Brian has been instrumental in releasing multiple fiber optic cleaning solutions for a variety of optical connector types in both field and factory use. Brian holds a Bachelor of Science degree from the University of South Carolina and a Master of Business Administration degree from Florida State University.

SC186 Hands-on Specialty Fiber Splicing

This Short Course has been cancelled.

Monday, March 7, 2011
1:30 PM - 5:30 PM

Instructor: *Clyde J. Troutman; 3SAE Technologies, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The Hands-on Specialty Fiber Splicing course provides all attendees with an opportunity to operate a variety of fiber optic splicing equipment commonly used in both production and lab applications. The course begins with a brief classroom presentation that introduces attendees to the methods of fiber preparation and to the technical requirements of splicing optical fibers. Thereafter, participants are divided into small groups and rotated through splicing stations where each station highlights a specific splicing discipline, for example: Single Mode (SM), Polarization Maintaining (PM), Erbium, and Large Diameter Fiber (LDF). Because of each station's unique configuration, every attendee will operate a diverse selection of equipment used for fiber stripping, cleaning, cleaving, and splicing.

Benefits:

This course should enable you to:

- Differentiate between fiber preparation methods commonly used for stripping, cleaning, cleaving.
- Operate preparation and splicing equipment configured to maximize splicing performance.
- Compare splice alignment methods, including fixed v-groove, cladding and core alignment.
- Discuss specialty splicing applications including mode matching, PM, and large diameter fiber splicing.
- Understand the basics of splicer/splicing program optimization to minimize splice loss.
- Determine how to evaluate splice performance after completing a splice.
- Compare splice protection methods including sleeve and recoating techniques.

Audience:

The course is designed for engineers and lab technicians working in fiber optics research and development or manufacturing. Participants should have a basic understanding of fusion splicing and an interest in any of the fore mentioned objectives. Class size is limited to 12.

Instructor Biography:

Clyde J. Troutman is an Engineering Manager and Optical Applications Engineer with 3SAE Technologies. He has 10 years of experience in the development and in the improvement of specialty and custom fusion splicing practices and equipment. He has been teaching fiber optics training classes since 2000. He received his bachelor's degree in optical engineering from the University of Alabama at Huntsville.

SC291 Hands-on Fiber Optics for Engineers Designing for Military, Aerospace, Shipboard and Industrial Harsh Environmental Applications

Tuesday, March 8, 2011
8:00 AM - 12:30 PM

Instructor: *Dennis Horwitz; Micronor Inc., USA*

Level: Intermediate (prior knowledge of topic is necessary to appreciate course material)

Description:

This Short Course provides a very practical and interactive experience for the engineer involved in designing fiber optic components and systems for deployment in harsh environments. Whether military, aerospace, or industrial in nature, a harsh environment application encompasses one or more attributes (temperature, vibration, shock, etc.) that exceeds the "benign environment" baseline associated with commercial telecom/datacom oriented BELLCORE or IEC standards. (The military design might also refer to these commercial products as COTS—commercial off the shelf—which largely dominates the OFC/NFOEC exhibition floor.) The course takes the engineer through a quick, practical overview of fiber optics and then demonstrates a 10-step methodology for designing a fiber optic system for a harsh environment application. At each step the application as well as misapplication of COTS technology will be discussed, including lessons learned from similar programs. From soup to nuts, the course takes the participants through a generic system design and offer guidelines and background to assist decision making at each step: defining the system architecture and lifecycle requirements; choosing the right fiber, cable, and connectors; designing the cable plant; selecting active/passive components; establishing proper installation practices, performing system testing, and certification; developing proper maintenance /restoration methodology; establishing training standards; and evaluating system reliability. Throughout the course, the participants will also perform some hands-on fiber optic test and measurement experiments to best understand the nuances of working with optical fiber, interpreting test standards, and basic troubleshooting techniques. Opportunity will also be provided for open discussion of experiences and problems faced by the participants—to show how the course's materials and 10-step methodology can be applied.

Benefits:

This course should enable you to:

- Explain the difference between MIL-SPEC and COTS/BELLCORE as applied to fiber optic components selected for Harsh Environment applications.
- Determine the relevant environmental, operational, maintenance, reliability, and lifecycle requirements of the application for proper system design and planning.
- Explain pro/cons of DWDM versus GbE, FC, and other optical transmission techniques.
- Explain the fundamental differences and applications of single-mode fiber (SMF) versus multimode fiber (MMF), including the different fiber types and fiber sizes.

- Identify the different optical connector and cable types and understand their specific advantages/disadvantages plus suitability for various applications.
- Operate basic fiber optic test and troubleshooting equipment plus measure attenuation and return loss of optical cable plant cable to understand issues associated with launch condition and installation.
- Discuss lessons learned from a variety of military, aerospace, and industrial programs.
- Understand basic reliability and failure mode issues specific to fiber optic applications.

Audience:

The course is intended for engineers, technicians, or program managers who are involved in the design and deployment of fiber optic systems intended for harsh environment applications—whether military, aerospace, or industrial. At least a few years experience and basic understanding of fiber optics and harsh environment attributes is necessary to understand the course material.

Instructor Biography:

Dennis Horwitz received his M.S.E.E. from the University of California at Los Angles and has more than 30 years experience in research and development, product development, sales, and marketing of fiber optic test equipment and components. He was co-founder of two successful start-ups in fiber optic test and measurement: Photodyne Inc. (1979–1990, sold to 3M) and Rifocs Corp. (1990–2003, sold to Textron). He is actively involved in fiber optic standards development (ARINC, ISA, SAE, and TIA) and has been an OFC/NFOEC Short Course instructor for more than 10 years. He is currently Vice President for Sales/Marketing for Micronor Inc., which has developed and commercialized the first totally passive fiber optic rotary encoder for motion control applications.

SC359 Datacenter Networking 101

New Course!

Tuesday, March 8, 2011
9:00 AM - 12:00 PM

Instructor: *Cedric Lam, Hong Liu; Google, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This introductory course starts with a review of the network transformations resulted from the rise of Internet computing applications. We then review the architectural structures of warehouse-scale computers (WSCs) and the networking technologies used to implement WSC datacenters. This course covers both intra-datacenter and inter-datacenter networks, the challenges facing datacenter operators in the next 3 to 4 years, the need for energy-efficient datacenter networking technologies, and the desirable optical networking technologies to sustain the growth of Internet computing applications.

Benefits:

This course should enable you to:

- Define warehouse-scale computer (WSC) and describe its structure.
- Describe the engineering principles and philosophies behind scalable mega-datacenter infrastructures.
- Compare different datacenter cluster topologies and switching technologies.
- Compare the differences and similarities between traditional telecommunication networks and booming data-communication networks.
- Identify the challenges for intra-datacenter and inter-datacenter communications.
- Select suitable optoelectronic interconnect technologies.
- Explain the roles of optics in transmission, multiplexing, and switching.
- Identify designs to realize energy efficient data networks.

Audience:

This course is beneficial to optoelectronic engineers, fiber optic transceiver designers, and optical transmission engineers who would like to understand the requirements of datacenter networking. It also benefits network engineers with the knowledge of high-speed optical communication technologies used to realize various datacenter network applications. For network planners and architects, this course provides outlooks in optical network technology developments in the next 3 to 4 years.

Instructor Biography:

Cedric F. Lam is currently an Optical Network Architect at Google. Before joining Google, he worked at OpVista Inc. as Chief System Architect, responsible for the development of an ultra-dense WDM transport system with integrated ROADM functionality. Prior to OpVista, Cedric was Senior Technical Staff Member at AT&T Labs-Research. His research covers broadband optical transport and access networks architectures, optical signal modulation and transmission, passive optical network, HFC, etc. His current focus is in FTTH and optical networking technologies for datacenter applications. Cedric received a B.Eng. in electrical and electronic engineering from the University of Hong Kong with First Class Honors and a Ph.D. in electrical engineering from the University of California in Los Angeles.

Hong Liu is a Member of Technical Staff at Google Platform Advanced Technology, where she is involved in the system architecture and interconnection for large-scale computing platforms. Her research interests include interconnection networks, high-speed signaling, photonic integrated circuits, and optical metro design. Prior to joining Google, Hong was a Member of Technical Staff at Juniper Networks, where she was principally involved in the architecture and design of high-end physical interface cards, network routers, and multi-chassis switches, including Juniper's flagship core router T640, edge routers M7i/M10i/M120, the world's first OC768 line card, and the world's very first switch-matrix TX640. Hong received her Ph.D. in electrical engineering from Stanford University.

SC347 Reliability and Qualification of Fiber-Optic Components

Tuesday, March 8, 2011
2:00 PM - 6:00 PM

Instructor: *David Maack; Corning, USA*

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

Reliability is one of the most important requirements for our modern telecommunication systems. It is one of the first areas of intensive inquiry for a new supplier and potentially one of the biggest problems in deployed systems. An unreliable sub-component can easily bring down entire systems and, in the worst scenario, force recalls costing thousands of times the original components price leading to substantial financial liabilities and highly strained customer-vendor relationships.

Qualification programs are performed primarily to reduce the high costs of true reliability programs and, as such, act as a proxy for reliability. Passing of the qualification tests is assumed to assure a certain level of reliability with confidence that the component meets the requirements for a particular application. Although this assumption generally holds true in mature industries such as electronics where the modes of failure are well understood, it can be a dangerous path to follow in technically immature industries such as photonics. Qualification and reliability must both be done for photonic components.

This "new" course is a combination of two prior courses, 'Reliability Methodologies for Fiber Optic Components" and "Qualification Programs for Fiber Optic Components," along with new material which tries to bridge the relationship and gap between qualification and reliability. When is it appropriate to rely on the qualification tests and when must expensive and time consuming reliability models be developed? This is a difficult balance that goes beyond just technical analysis; it involves risk taking, business decisions, judgment, and experience.

Benefits:

This course should enable you to:

- Understand the difference between performance, qualification, and reliability testing.
- Discuss and learn what constitutes a complete qualification program and get the author's interpretation of the "letter of the law" for the most popular standards.
- See detailed charts comparing different qualification standards.
- Appreciate what each of the qualification tests really test for and its limitations.
- Determine why and when reliability testing and modeling needs to be done.
- Establish appropriate reliability tests and gather meaningful data.
- Apply the basics of reliability testing and modeling mathematics to determine the proper statistical distribution for a set of failure data.
- Calculate the reliability of a device using accelerated testing data with case studies for guidance.
- Find information on standards, components, reliability software, and other reference materials.
- Read reliability and qualification reports and determine their adequacy.

Audience:

This course is intended for a general audience including non-technical persons with no particular background except an interest in or need for knowledge of reliability and qualification of fiber optic components. It is meant to impart valuable information to audiences of all levels.

Instructor Biography:

David Maack has more than 30 years of engineering and management experience in photonics with the last 12+ years in qualification and reliability for passive and active fiber optic components. Currently, he is the reliability lead for the Green Laser Project at Corning, Inc. in Corning, New York. He is the past chairman of the IEC TC86B Working Group 5 writing standards for passive fiber optic components, has participated in multiple Telcordia GR rewrites, and is the author of numerous papers. He has bachelor's degrees in physics and nuclear science along with a master's degree in business administration.

SC182 Biomedical Optical Diagnostics and Sensing

Tuesday, March 8, 2011
2:00 PM - 6:00 PM

Instructor: *Thomas Huser; Univ. of California at Davis, USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

This course provides an introduction to the basics of life sciences, followed by an introduction to the basic properties of photons and the spectroscopic properties of biological materials, i.e. absorbance, reflectance, polarization, fluorescence, and light scattering. Modern optical imaging techniques—based on fluorescence, vibrational and nonlinear concepts—and their medical applications will be discussed.

Benefits:

This course should enable you to:

- List biologically relevant processes.
- Describe the composition of typical mammalian cells and how they can be imaged and analyzed in vivo.
- Define the best optical tools for the study of biological processes.
- Provide assistance in the design, construction and application of optical techniques to biological systems.
- Suggest and specify techniques that specifically highlight parts of interest within biological cells by employing optical tags.
- Read optical spectroscopic signatures of cells and discuss them in a meaningful way.

Audience:

This course in intended for technicians in industrial, academic and government laboratories; graduate students; managers in biotech and optical industries; postdoctoral fellows; optics researchers or teachers interested in the life sciences.

Instructor Biography:

Thomas Huser is an Associate Professor in the department of internal medicine and the Chief Scientist for the NSF Center for Biophotonics Science and Technology (CBST) at the University of California at Davis. Until November 2005, he was a Group Leader for biophotonics and nanospectroscopy at Lawrence Livermore National Lab (LLNL). He obtained his doctorate in physics from the University of Basel, Switzerland, where he worked on near-field optical microscopy. At the University of California at Davis he applies fluorescence and Raman spectroscopy to biological and medical problems at the single molecule to single cell level.

SC314 Hands-on Fiber Characterization for the Engineering of Long Haul and Metro Deployments

Tuesday, March 8, 2011
2:00 PM - 6:00 PM

Instructor: *Daniel Peterson[1], Christine Tremblay[2]; [1]Verizon, USA, [1]École de Technologie Supérieure, Univ. du Québec, Canada*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

In this hands-on course you will measure all of the necessary fiber parameters for qualifying and engineering the optical fiber links of long haul and metro networks at a specified bit rate. The course will begin with a review of the basics of loss, reflectance, chromatic dispersion, and polarization mode dispersion in optical fiber links, as well as the challenges in moving from 10G to 40G and 100G bit rates. Bit-rate dependent loss and dispersion limits will be calculated for fiber qualification purposes. Descriptions of the course equipment and experimental setups will follow. The participants will then divide into small groups and rotate among four lab stations. In Lab 1, participants will measure loss and optical return loss in optical fiber links using power meters and optical time-domain reflectometers (OTDR). In Lab 2, participants will measure the chromatic dispersion in optical fiber links using two different measurement techniques. The first one is the time-of-flight method and the second is the phase-shift method. Christine Tremblay is the instructor. In Lab 3, participants will measure the polarization mode dispersion (PMD) in optical links with combinations of high-PMD fibers using different measurement techniques: the interferometric method, the fixed analyzer method, the Stokes parameter evaluation method and the random-scrambling tunable POTDR method. Daniel Peterson is the instructor. The course will conclude with a review of the pros and cons for each method as well as an analysis of measurements results. Please note that the PMD portion of SC314 and SC210 overlaps in content.

Benefits:

This course should enable you to:

- Learn about transmission limits as a function of bit rate and application.
- Gain the knowledge to make decisions on when specific fiber testing is necessary dependent on the application.
- Measure polarization-mode dispersion (PMD) using Interferometric and JME methods.
- Measure chromatic dispersion (CD) using both time-of-flight (TOF) and phase-shift methods, and discuss CD compensation in mixed-fiber type mesh environments.
- Discuss the effect of PMD and chromatic dispersion on high-speed digital signals.
- Discuss the outage probability in optical fiber transmission systems due to PMD-induced degradation.
- Take optical time-domain reflectometry (OTDR) for loss and splice characterization.

- Describe the system-level effects of polarization-related impairments on long-haul optical transmission.

Audience:

This course is intended for engineers, technicians and managers involved with optical fiber, components or systems, including those that operate at or above 10Gb/s.

Instructor Biography:

Daniel Peterson is a Distinguished Member of the Technical Staff at Verizon. He has directed the characterization of the ULH network fiber. He is an internal advisor on optical technologies and is responsible for specifying new optical fiber and characterization of older fiber for Verizon's ULH network. Peterson is also an adjunct professor at the University of Texas at Dallas. He received a Ph.D. (electrical engineering) from the University of Texas.

Christine Tremblay is a professor at the École de Technologie Supérieure, Université du Québec. She set up the Laboratoire de technologies de réseaux, a high-speed WDM physical layer test-bed, and established courses on optical communications and networking. Her current research includes the exploration of optical layer characterization techniques and novel optical network architectures. She also held senior R&D and technology management positions at Nortel, EXFO, and INO. She received a Ph.D. (optoelectronics) from the École Polytechnique de Montréal.

2011 Tutorial Speakers

OFC/NFOEC tutorial presentations are one-hour instructional talks designed to provide reviews of important progress in research. Speakers are chosen through a highly selective nominations process to keep attendees at the forefront of optical communications. This year's exciting lineup of tutorial speakers will cover various topics in the categories below.

Category 1. Optical Network Applications and Services
Category 2. Network Technologies and Applications
Category 3. FTTx Technologies, Deployment, and Applications
Category 5. Fibers and Optical Propagation Effects
Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors
Category 7. Optical Devices for Switching, Filtering, and Signal Compensation
Category 8. Optoelectronic Devices
Category 9. Digital Transmission Systems
Category10. Transmission Subsystems and Network Elements
Category 11. Optical Processing and Analog Subsystems
Category 12. Core Networks

Category 13. Access Networks
Category 14. Datacom, Computercom, and Short Range and Experimental Optical Networks

Category 1. Optical Network Applications and Services

NTuC1 Implementing a Network Control Plane, Sri Subramania; *Telcordia, USA*

Category 2. Network Technologies and Applications

NTuA1 ASON/GMPLS Control Plane for Transport Networks—Current Status, Lyndon Ong; *Ciena Corp., USA*

Category 3. FTTx Technologies, Deployment, and Applications

NMD1 Passive Optical Networks: Current and Next-Generation Technologies, Elaine Wong; *Melbourne Univ., Australia*

Category 5. Fibers and Optical Propagation Effects

OTuJ4 Microstructured Optical Fibers: Making Fibers Better By Leaving Bits Out, Jonathan Knight; *Univ. of Bath, UK*

OTuA4 Numerical Modeling Methods in Optical Fiber Design, John Fini; *OFS Labs, USA*

Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors

OThL1 Carbon-nanotube and Graphene Photonics, Shinji Yamashita; *Univ. of Tokyo, Japan*

Category 7. Optical Devices for Switching, Filtering, and Signal Compensation

OTuD1 ROADM Switching Technologies, Paul Colbourne; *JDSU, USA*

Category 8. Optoelectronic Devices

OMU5 Enabling Components for Future High-Speed Coherent Communication Systems, Sethumadhavan Chandrasekhar, Xiang Liu; *Bell Labs, Alcatel-Lucent, USA*

Category 9. Digital Transmission Systems

OWF1 Low-Density Parity-Check Codes and Message Passing Algorithms, Gerhard Kramer; *Univ. of Southern California, USA*

OWX1 Quantum Physics in Optical Communication Systems, Colin McKinstrie; *Bell Labs, Alcatel Lucent, USA*

OThX4 **Ultra High Capacity Transmission for Optical Transport Network**, Yutaka Miyamoto; *NTT Basis Res. Labs, Japan*

Category10. Transmission Subsystems and Network Elements

OThE1 **Agile Subsystems for Coherent Systems beyond 100G**, David Boertjes; *Ciena Corp., Canada*

OTuN1 **High-Speed CMOS DSP and Data Converters**, Ian Dedic; *Fujitsu Microelectronics Europe GmbH, UK. Presentation not on Technical Digest CD-ROM. Click here to view presentation.*

OWN1 **Metrology of Complex Optical Modulation Formats**, Peter Andrekson; *Chalmers Univ. of Technology, Sweden*

Category 11. Optical Processing and Analog Subsystems

OMT1 **Achievements and Future Prospects of Wavelength Conversion and All-Optical Regeneration**, Ernesto Ciaramella; *Scuola Superiore Sant'Anna, Italy*

OTuO4 **Cost Effective Fiber Wireless Networks and System Technologies**, Thas Ampalavanapilla Nirmalathas; *Univ. of Melbourne, Australia*

Category 12. Core Networks

OWI5 **Energy-Efficient Networks**, Daniel Kilper; *Bell Labs, Alcatel-Lucent, USA*

OMN1 **Optical Network Architectures**, Michael Dueser; *T-Systems Enterprise Services GmbH, Germany*

Category 13. Access Networks

OMG3 **OFDM in Optical Access Networks**, Neda Cvijetic; *NEC Labs America, USA*

Category 14. Datacom, Computercom, and Short Range and Experimental Optical Networks

OWU4 **Low-Power, High-Density Optical Interconnects to the Processor**, Ashok Krishnamoorthy; *Oracle/Sun Microsystems Labs, USA*

OThH3 **Optical Interconnects for High Performance Computing**, Marc A. Taubenblatt; *BM T. J. Watson Res. Ctr., USA*

Workshops and Panels

OFC/NFOEC Workshops provide opportunities to discuss and debate the latest technologies. Workshops will be highly interactive, amongst both the speakers and the audience. The format of each session is determined by the organizers. In the past, many workshops have consisted of a series of short presentations (5 to 10 minutes) from people involved in the field followed by a panel discussion driven by questions from the audience.

The 2011 conference features workshops in current areas of interest in optical communications. All OFC/NFOEC attendees are encouraged to participate. Workshops will be held on Sunday, March 6, 4:30 p.m.–7:30 p.m., and Monday, March 7, 8:00 a.m.–11:00 a.m. The workshops provide an interactive learning environment and are open to all conference registrants.

Panel sessions provide interactive discussions focused on topics of interest to the industry. Panel discussions are comprised of industry panelists and represent a broad range of viewpoints and technology. Panels will be held throughout the week, and all OFC/NFOEC technical registrants are encouraged to attend these exciting session.

Like invited and tutorial speakers, workshop and panel topics and organizers are chosen through a highly selective nominations process.

Category 1. Optical Network Applications and Services
Category 2. Network Technologies and Applications
Category 3. FTTx Technologies, Deployment, and Applications
Category 5. Fibers and Optical Propagation Effects
Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors
Category 7. Optical Devices for Switching, Filtering and Signal Compensation
Category 8. Optoelectronic Devices
Category 9. Digital Transmission Systems
Category 10. Transmission Subsystems and Network Elements
Category 11. Optical Processing and Analog Subsystems
Category 12. Core Networks
Category 13. Access Networks
Category 14. Datacom, Computercom, and Short Range and Experimental Optical Networks

Category 1. Optical Network Applications and Services

Panel: NME Network Requirements of Warehouse-Scale Computing for Cloud Applications

Panel: NThA Tradeoffs and Drivers for Tunable/Colorless Networks

Workshop: NSuA Beyond 100G, Options and Implications for Today's Networks

Category 2. Network Technologies and Applications

Panel: NThE Electronic Mitigation of Transmission Impairments, from 10 Gbps through 100 Gbps—Component Vendor Pe

Panel: NWE 100G Technology and Deployment

Workshop: NMA Next Generation Network Convergence: How will the Architectures of Mega-Data-Centers and Traditional

Category 3. FTTx Technologies, Deployment, and Applications

Workshop: NMB FTTX: What Does X Mean to You?

Panel: NWB Advances in PON Systems and Deployment Technologies for PON Systems

Panel: NMF Drivers and Applications for High-Speed PON Systems

Panel: NWF FTTH Around the World: Today and Tomorrow

Category 5. Fibers and Optical Propagation Effects

Workshop: OSuA Next-Generation Fibers for High Capacity Transmission—Radical Solutions

Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors

Workshop: OSuB Best Saturable Absorber for Mode-Locked Fiber Lasers: SESAM, CNT, or Graphene?

Category 7. Optical Devices for Switching, Filtering, and Signal Compensation

Workshop: OMB Is Si Photonics Applicable to the Telecom Industry?

Category 8. Optoelectronic Devices

Workshop: OSuC Photonic Integration: More Technologies than Applications?

Category 9. Digital Transmission Systems

Workshop: OMD Flexible Optical Networking Capacity at Its Limits?

Category 10. Transmission Subsystems and Network Elements

Workshop: OSuE Software Defined Optical Transceivers – What Can We Do with Them?

Category 11. Optical Processing and Analog Subsystems

Workshop: OSuD Where Can Optical Analog-Digital Conversion Compete?

Category 12. Core Networks

Workshop: OMC Spectrally/Bit-Rate Flexible Optical Network Design and Operation

Category 13. Access Networks

Workshop: OSuF What Is Next for High-Speed PON: Evolution or Revolution?

Workshop: OME Wireline and Wireless Access Network Integration/Convergence

Category 14. Datacom, Computercom, and Short Range and Experimental Optical Networks

Workshop: OMA Exascale Computing: Where Optics Meets Electronics

Network Requirements of Warehouse-Scale Computing for Cloud Applications

Category 1. Optical Network Applications and Services

NME

Monday, March 7, 2011
4:00 PM - 6:00 PM

Event type: Panel

Room number: 515A

Organizer: Paulie Germano; *Google, USA*

Description:

The ever-increasing ubiquity and speed of Internet access has enabled applications to move from the desktop to a Web-based service delivery model. This distributed model is commonly referred to as cloud computing.

The underlying infrastructure consists of data centers housing massive amounts of compute and storage resources. These resources are not simply a collection of servers but a carefully controlled and scheduled distributed machine. The network plays an critical role in maximizing

the efficiency of the most expensive component of these systems, the servers themselves, by reducing constraints on workload placement.

The panel will consist of experts in the cloud computing space and will cover the unique network requirements, design challenges, and desired future hardware and software features of these systems and their components.

Speakers:

Donn Lee, *Facebook, USA*

Bradley McConnell,*Rackspace, USA*

Loukas Paraschis, *Cisco, USA*

Peter Coffee, *Salesforce, USA*

Tradeoffs and Drivers for Tunable/Colorless Networks

Category 1. Optical Network Applications and Services

NThA

Thursday, March 10, 2011
8:00 AM - 10:00 AM

Event type: Panel

Room number: 515A

Organizer: Zeljko Bulut; *Nokia Siemens Networks, USA*

Description:

Rapid service provisioning, OpEx reduction through automation, and more efficient bandwidth utilization are the key drivers for the deployment of dynamically reconfigurable optical networks. While some key ingredients necessary to build tunable ROADMs have been available for some time, fully operational tunable networks are yet to be offered and deployed. Beside tunable ROADMs and transponders such solutions must deliver a well-tuned control plane with an integrated physical layer engine. A number of technologies today are competing to enable the most optimized and cost-efficient ROADM architecture, each with its own inherent set of advantages and disadvantages. We will discuss the business drivers for tunability and explore

these key technologies and tradeoffs facing equipment suppliers and network designers when considering deployments of new optical infrastructure.

Speakers:

Hai-Ping Wu, *AT&T, USA*

Steve Frisken, *Finisar, Australia*

Paul Morkel, *Infinera, USA*

Thomas Strasser, *Nistica, USA*

Roman Egorov, *Verizon, USA*

Sander Jansen, *Nokia Siemens Networks, Germany*

Beyond 100G, Options and Implications for Today's Networks

Category 1. Optical Network Applications and Services

NSuA

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Event type: Workshop

Room number: 515B

Organizer: Glenn Wellbrock; *Verizon, USA*

Description:

Current generation WDM systems supported individual channel bit rates of 10Gb/s, 40Gb/s and even 100Gb/s without any significant changes to the line system itself, thus setting the expectation very high for next generation platforms. In this workshop, we will review the technologies that enabled the successful introduction of 100G and explore ways to ensure scalability of future transport systems by improving spectral efficiency and lowering the cost per bit without impacting reach or performance.

Speakers:

TJ Xia; *Verizon USA*

Lynn Nelson; *AT&T, USA*

Milorad Cvijetic; *NEC, USA*

Frank Chang; *Vitesse, USA*

Kim Roberts; *Ciena, USA*

Daniel Blumenthal; *UCSB, USA*

Christoph Glingener; *ADVA, Austria*

Electronic Mitigation of Transmission Impairments, from 10 Gbps through 100 Gbps—Component Vendor Pe

Category 2. Network Technologies and Applications

NThE

Thursday, March 10, 2011
3:30 PM - 5:30 PM

Event type: Panel

Room number: 515A

Organizer: Norman Swenson; *Clariphy Communications, USA*

Description:

Evolution of the WAN and LAN from 10 Gbps to 100 Gbps and beyond places ever-increasing demands on optical, electro-optic, and electronic components to mitigate transmission impairments in a cost-effective and power efficient manner. Recent developments have emphasized mitigation in the electronic domain through a combination of powerful signal processing techniques and innovative optoelectronic design. This panel will consist of industry experts from the component supply chain addressing new directions and challenges as carriers and cloud computing operators push data rates to 100 Gbps and beyond. Topics will include new

modulation schemes, power efficient coding, advanced optoelectronic integration, and the demands placed on component vendors supplying these technologies.

Speakers:

Roberto Marcoccia, Juniper, USA

Pavel Mamyshev, Oclaro, USA

Milind Gokhale, Santur, USA

Janis Valdmanis, Picometrix, USA

Oscar Agazzi, ClariPhy, USA

Yurii Vlasov, IBM Research, USA

100G Technology and Deployment

Category 2. Network Technologies and Applications

NWE

Wednesday, March 9, 2011
3:30 PM - 5:30 PM

Event type: Panel

Room number: 515A

Organizer: Michel Chbat; *Nokia Siemens Networks, USA*

Description: The first widely-deployable 100G products, offering fiber capacities close to 10Tbps, are scheduled to appear in 2011, only 4 years after the first demonstrations confirmed the suitability of the coherent technology for 100G transport. This compressed cycle from research to field implementation---less than half that of 40G---owes to a rapid convergence of technical solutions, remarkable advances in DSP technology, a highly focused standardization effort, and a stable supplier ecosystem. Numerous field trials have been performed, asserting the readiness of several network infrastructures to 100G, and early product announcements and deployments have already taken place. This panel, with participants from network operators and equipment and component suppliers, will address the field of 100G from various aspects: technology, supply chain, standards, and network design, performance and deployment.

Speakers:

Masahito Tomizawa, *NTT, Japan*

Glenn Wellbrock, *Verizon, USA*

Amy Wheelus, *AT&T, USA*

Uwe Fischer, *Nokia Siemens Networks, Germany*

Michael Frankel, *Ciena, USA*

Rafik Ward, *Finisar, USA*

Next Generation Network Convergence: How will the Architectures of Mega-Data-Centers and Traditional

Category 2. Network Technologies and Applications

NMA

Monday, March 7, 2011
8:00 AM - 11:00 AM

Event type: Workshop

Room number: 404 A&B

Organizer: F.Joachim Westphal, Andreas Gladisch; *Deutsche Telekom Laboratories, Germany*

Description:

Over the last couple of years the traditional telco networks have evolved towards IP based networks were services are basically enabled by processing and storage in data-center. Moreover, due to the ubiquity of access to the Internet, Web based services are of increasing popularity and economy of scale effects drive even enterprises to the "cloud." So, the importance of data-center is massively growing and performance as well as scalability of their architectures is challenged. In this context, the networks in and in-between data-centers play a crucial role in maximising the overall efficiency and performance.

As a result the interconnection of data-centers is one of the largest contributors to the increase of traffic demand in backbone networks. The structure of the Internet has started to change towards

a flatter hierarchy and a more dense interconnection with consequences for routing, traffic engineering and security. In consequence the role of telco transport networks as an intermediate between content and eyeball networks is changing, too. Taking these constraints into account while discussing new overarching network architectures will increase the performance of already existing services and give the chance to create new business for all players involved.

This workshop addresses the consequences of the rapidly increasing influence of data-center network architectures / design and requirements on traditional telco networks and vice versa.

The individual views from the perspective of telecom network providers and mega-data-center operators on network architectures and management of the different realms and their potential convergence will be covered in the contributions of this workshop.

Speakers:
Paulie Germano, *Google, USA*
Mallik Tatipamula, *Ericsson, USA*
Ed Rathke, *Verizon, USA*
Loukas Paraschis, *Cisco, USA*
Andreas Gladisch, *Deutsche Telekom, Germany*

FTTX: What Does X Mean to You?

Category 3. FTTx Technologies, Deployment, and Applications

NMB

Monday, March 7, 2011
8:00 AM - 11:00 AM

Event type: Workshop

Room number: 515B

Organizer: Marek Hajduczenia; *ZTE Corp., Portugal*

Description: Fiber in the access loop is rapidly gaining ground versus competitive technologies (copper, HFC) and together with the wireless represents the networking paradigm of tomorrow for access networks. However, when we look across the board and examine how fiber is used and what applications it serves, the image is very fragmented. This situation is very well reflected in the slur of marketing acronyms, generating a wave of FTTX acronyms, indicating the target application for fiber access of the given service provider. We hear about fiber to the house, business, node, base station, village, campus etc. It is a very complex environment, and in this workshop we will try to have a closer look at what the X in the FTTX means for individual

operators, service providers, technologists, or even everyday service consumers. We will take a peek at various ways of using fiber in the access, novel fiber applications and some of the upcoming technologies.

Panel Discussion: Where Do You See FTTx Going by OFC 2015?

X Means Energy Efficiency
Mike Bennet; Lawrence Berkeley Natl. Lab, USA
Energy-use is an underlying issue whatever "X" means in FTTX. Service providers need more efficient ways to deliver traffic via FTTX. Bandwidth consumers are always looking for ways to lower operational expenses, whether in the home or the enterprise. Optical transport is by far the most efficient means to deliver traffic to the consumer. Thus, FTTX means achieving energy efficiency and therefore minimizing OPEX for your organization.

Michael Bennett is a Senior Network Engineer at Lawrence Berkeley National Lab with over 30 years of combined experience in electronics and enterprise networking. He co-manages the LBLnet Services Group which is responsible for operating LBNL's Campus Area Network. Mike is an IEEE standards association member, a contributor of end-user's perspective to several Ethernet standards and former Chair of the IEEE P802.3az Energy Efficient Ethernet Task Force.

FTTx: How Deep and When?
Victor Blake; MSO Consultant, USA
FTTx is the use of fiber anywhere in the access network. The x represents the name for the location where the signal is converted from fiber to copper. Examples of FTTx include DLC, xDSL when a remote terminal is used, or Hyrbrid Fiber Coax (HFC). The first two use fiber with one technology from an operator's regional or metro network to a remote cabinet where a different copper (twisted pair) technology is used for last mile access. HFC also has fiber to a remote location. From there to the customer premise is copper (coaxial cable). HFC is different because only the media is converted at the remote location (called a node). The signals are converted from fiber to coax (downstream) and from coax to fiber (upstream) at the node. The node is protocol transparent. In short, it is a regenerator, not a repeater (or bridge) or transponder.

Victor Blake received his B.S. in Computer Engineering Technology from Rochester Institute of Technology and M.S. from Syracuse University. He is an experienced strategist, architect, and operations engineer. He also has significant marketing and product management experience. Mr. Blake is an advisor and consultant for service providers and vendors. He has done work for companies including multiple cable operators, ISPs, system vendors, and chip vendors. He was active in the development of DOCSIS 3.0 chaired the now completed DOCSIS Provisioning of EPON (DPoE) specification development effort. Today he is active in SCTE, IEEE, CableLabs, and ITU-T standards work in PON access technologies for cable. He has published articles and papers in Lightwave Magazine, Communications Technology, 4G World, Data Communications, LAN Times, Business Communications Review, and Network VAR. He has also taught undergraduate and graduate courses at both RIT and Syracuse University. Mr. Blake is a member

of the IEEE, SCTE, OSA, SPIE, and CTAM. He is a Standards Member of SCTE and Advanced Corporate Member of IEEE Standards Association.

FTTx a Changing Paradigm in Europe
Fabrice Bourgart; France Telecom, France
In FTTx, as long as x represents a reference to an architecture option, it shows that the discussion remains among experts in technologies. Real maturity comes when non-experts replace x with applications acronyms and users express the services they expect whenever a real broadband facility will be available. More and more such presentations are given by politics in Europe that clearly show that fibre access becomes an essential facility for its territory that will require the path to be smoothed for countries and investors to deploy. The intent of the presentation is to browse through several ways to consider FTTx in Europe (Politics, Regulator, ILEC, CLEC and last but not least the end users). Some proposals for x values will be made to illustrate some evolution from early deployments towards a mandatory facility: e.g: FTTTA Fibre to the (my) territory attractivity, FTTM M for Mobility, FTTPMS Public money saving. Hopefully some recent news with new steps towards more deployments in Europe will be integrated.

After obtaining his engineering diploma in Electronics and Telecoms from ENSEIRB in Bordeaux (France), Fabrice Bourgart joined the French CNET research center, where he started working in the optical access domain. There, he began his career by optimizing opto-electronics for TPON systems for lab demonstrators. Over the years he covered most of the technical aspects of optical access, from global system design, including both hardware and software aspects, to full network integration of new systems with service engineering and operating processes attached to the deployments. He then managed several projects on deployment of optical access field trial and pre-deployments in FT. Through participation to Eurescom projects and ETSI standards he also studied optical plant monitoring and OAM aspects. In 2005 he became delegate for France Telecom Orange Labs. for ITU-T where he has been active as co-editor of XG-PON documents G.987.1 and joined the FSAN where he is now co-chairing the Next Generation PON activities.

What the X Means in FTTX in KDDI Access Network
Ryo Inohara; KDDI Labs, Japan
KDDI is a unique company having not only FTTH network but also CATV HFC network. In this presentation, KDDI's strategies for the optical access networks and services are introduced. The recent discussion of Japanese governmental initiative, "Road of light" (100% availability of high-speed broadband network (mainly by FTTH) to all household by 2015) and the recent status of fiber deployment in Japan are also discussed.

He joined KDDI R&D Laboratories Inc. in 2001. He has been engaged in the research of all-optical regeneration and wavelength conversion about four years since he joined KDDI. His current research activity includes optical access network and CATV network technology. He received the B.E. and M.E. degrees in Communications Engineering from Osaka University, Osaka, Japan in 1999 and 2001, respectively.

Bandwidth Requirements in FTTx Systems: Higher (and Lower) Than You Might Think

Lowell Lamb, Broadcom, USA

The business case for FTTx is straightforward: more bandwidth than can be supplied by legacy access networks is needed for the new generation of IP-based services. These applications, viewed as key sources of revenue by many network operators, are driving the deployment of access fiber throughout the world. This presentation discusses the dynamic bandwidth requirements of IPTV and cloud computing, which exhibit markedly different behavior on various time-scales of interest and serve as concrete examples of the challenges facing access networks today. Finally, some of the architectural implications of supporting these applications, both for the core network and the PON system, are reviewed.

Lowell D. Lamb is a Technical Director in the Ethernet Access Group of Broadcom Corporation. Prior to Broadcom, Lamb was the Vice President of Marketing and later Chief Strategy Officer of Teknovus. Earlier in his career, Lamb was the Director of PON Networks for Terawave Communications, the Assistant Director of the Arizona Fullerene Consortium at the University of Arizona, and held positions at SBC Laboratories and the Federal Reserve Bank of New York. Mr. Lamb holds a Ph.D. in physics from the University of Arizona and is the author of more than 30 publications and patents.

FTTX and Technical Challenges of Emerging Applications: How Do We Keep Up with the Pace of Digital Evolution

David Li; Ligents Photonics, USA

With the growth of broadband access demands, the number of FTTX users has been increasing all over the world and the PON system is widely deployed as a cost effective optical network. In the near future, the demand for next generation PON for further enhancing the capabilities in terms of service offerings and capacity is expected to be increased. This presentation will review the technologies and evolution on both the key optical and electrical components available for the PMDs in the next generation PON applications. The challenges in the new optical components and electronics for the NG PON will be discussed. Possible scenarios that combine the various component techniques for the NGA will also be presented. The technical feasibilities, physical layer specification and cost for the PMDs in the different PON configurations will be considered.

David Li is the Chief Technology Officer of Ligent Photonics (USA) and Vice President in Hisense Broadband Multimedia Technologies. He received his bachelor degree from Shandong University and the MSEE from Beijing University of Aeronautics and Astronautics. He got the Doctor of Engineering degree from University of Electronic Science and Technology of China and the Ph.D. from University of Houston, respectively. Prior to joining Hisense-Ligent in 2002, he held a variety of positions as associate professor, principal design engineer, technical supervisor, and director of engineering in UESTC, CUHK, Texas Center for Superconductivity, Epsilon Lambda Electronics, and Molex Fiber Optics. He has been involved in the design and manufacturing of the high-speed electrical, optical modules and subsystems for more than 20 years. Since 2000, David has been participating the IEEE802.3ae/ IEEE802.3ah/ IEEE802.3av and FSAN meetings actively. Following the standard activities, he lead his team developed the innovative EPON ONU/OLT with accurate monitoring functions, GPON ONU/OLT modules, 10G-EPON symmetric and asymmetric modules, NG-PON1 modules, and WDM-PON modules, which have been widely deployed around the world.

FTTx and Security for User Data

Paolo de Lutiis; Telecom Italia, Italy

NGN will enable delivery to users of enriched, bandwidth aggressive, communication services such as Internet Protocol Television (IPTV), High Definition TV (HDTV) and multimedia P2P-based services. The availability of a true ultra broadband access network is a cornerstone for the success of such services, and optical fiber in the local loop are actually the best candidate for implementing NGA networks. Although usually considered more secure than copper, also fiber-based infrastructures require proper security mechanisms in order to avoid dangerous situations which can threaten, for example, the Lawful Interception system, billing, assurance, management processes and so on. The contribution will describe a short risk analysis with examples of insecurity and main threats to which PON-based NGAN are subject. Then it will be describe the latest mechanisms identified within the main SDO and fora, such as authentication and access control mechanisms; in particular will be described the new ITU-T G.987 (XG-PON) security mechanisms.

Paolo De Lutiis, graduated in Computer Science from the Turin University (Italy), is specialized in computer security. He works in Telecom Italia in the Security Innovation dept. and is currently involved on internal projects related to the security of the NGN and NGA. He is strongly involved in the international standardization of security techniques, serving as Chairman of ETSI TISPAN WG7 (Security) and rapporteur of NGN security deliverables. He has been also involved in the ITU-T specifications of the security mechanisms for the G-PON and XG-PON access networks.

FTTx Deployment in the UK and Future Evolution

Derek Nesset; British Telecom, UK

In the UK, BT began large scale deployments of fibre access in 2010 with a stated target of 10M homes passed in 2012 (75% FTTC, 25% FTTP). The FTTC service will utilise VDSL2 over existing copper connections from the street cabinet and FTTP will utilise GPON technology with fibre all the way to the customer premise. We describe the high level strategic thinking behind this deployment and describe the commercial model whereby Openreach (a BT Group business) will sell fibre access products on an equivalent basis to all UK service providers. The future evolution options for fibre access, both planned and speculative, will also be reviewed.

Derek Nesset leads BT's research into future optical access networks within BT Research and Technology. He started work for BT in 1989 and spent several years developing photonic components for fibre optic communication systems. Following this, he investigated the applications of semiconductor optical amplifiers to fibre optic systems up to 100Gbit/s. This included the first field demonstration of 40Gbit/s transmission over BT's fibre infrastructure. In 2000 he joined Marconi Communications to develop ultra-long-haul, terrestrial, DWDM systems and lead on activities relating to ROADM and dynamic gain flattening subsystems. He returned to BT in 2003 to conduct research into the physical layer issues for enhanced PON systems. His current interests are PON reach extension technologies and next generation PON systems such as WDM-PON. He has a BSc in Physics and an MSc in Telecommunications Engineering and is a

member of the IEEE. He has authored or co-authored over 80 journal and conference publications and has 6 patents. He serves on the Access Networks subcommittee for OFC and is co-chair of the NG-PON Task Group in FSAN.

Verizon FTTP deployment, What It Will Look Like in 5 Years
Vincent A. O'Byrne, Verizon, USA
Verizon has been deploying FTTP since mid 2004 migrating from BPON to GPON and now looking at the next technology (NG-PON) as well as looking at migrating more business services on its PON infrastructure. In this presentation we try and look at what the architecture and services supported will be in 5 years time.

Dr. Vincent O'Byrne has over 27 years of experience in Telecommunications in both the wireless and wireline arenas. Vincent is the Director of the FTTP Architecture and Design Group and his team is responsible for defining the access requirements for BPON, GPON and next generation access technologies as well as their evolution to meet the continued growth in customer demand and services. His present interests are in continuing to optimize the FTTP platform and the possible deployment of next generation technologies in the access space. He attended Kevin St. College of Technology in Dublin, received his BSC from Trinity College Dublin IRL, MSC from the University of Essex UK, a PhD from the University from Wales UK, and an MBA from Babson College US.


FTTX: What Does X Mean to You?
Duane Remein, FiberHome, USA
FTTB, FTTC, FTTH, FTTLA FTTN, FTTP, ...the significance of "x" and what it is commonly replaced with depends largely on where you live or who your Service Provider is. For most fiber served subscribers "x" is most likely replaced with "B" (which can be either Building or Basement, not to mention Business). The next largest group of fiber served subscribers probably thinks of "H" , as in Home, instead of "x. A quick tour around the globe reveals a patchwork of alphabet soup as each Provider struggles to make a profit in the new economy of FTTx.

For the past decade Mr. Remein has been actively involved in the development and standardization of PON systems. In 2009, he joined FiberHome where he currently holds the position of Technical Director of Standards; his focus is on fiber access standards development. Prior to joining FiberHome he launched the PON System Development team in 1999 at Alcatel-Lucent and was responsible for specification of the BPON/GPON systems and coordinated related standards activities. Before working in the fiber access arena, Mr. Remein oversaw project management and hardware development of the OC3/12/48 SONET product line. He has also worked for Siemens as hardware designer with a focus on embedded systems and processor design.

FTTx in Japan
Ken-Ichi Suzuki; NTT, Japan
Around 18 million subscribers receive FTTH/B services in March 2010 in

Japan. NTT has provided over 60% of these services using Gigabit EPON (GE-PON) systems mainly for single family houses. The remains have been provided using a combination of an Ethernet based P2P system and a VDSL system for multiple dwelling houses. Currently, we have started to employ PON based optical access systems to multiple dwelling houses directly. Therefore, we can consider that most of optical access services are provided using FTTH systems. Considering the current situation, I discuss required functions and their enabling technologies for 10 Gbit/s class PON systems to realizing FTTH systems effectively in Japan as post GE-PON systems, especially higher split ratio, long-reach, low power consumption, and so on.

He received the B.E. and M.E. degrees in electronic engineering from Utsunomiya University in 1988 and 1990, respectively, and received the Ph. D. degree in information science and technology from Hokkaido University in 2009. In 1990, he joined NTT laboratories, where he has been working on research and development of optical communication systems including passive optical network (PON) based optical access systems. His current research interests are 10G-EPON systems/technologies and optical-amplifier-based long-reach PON systems/technologies. He is an executive secretary of IEEE P1904.1 working group since 2010 and an associate editor of IEICE Transaction on Communications since 2007. He is a member of IEEE, OSA, and IEICE of Japan.

FTTx in S. Korea: Landmark Changes
Hosung Yoon; Korea Telecom, Republic of Korea
With the deep penetration of FTTH/B (fiber-to-the-home/building) broadband services, KT's fiber network is being rolled out closer to the user premises than ever before and considered as a source of the competitiveness for the future converged telecom services. In this presentation, I'll try to explain our efforts to provide new converged broadband services covering full spectrum of fixed, wireless, and mobile access; the optical network technologies which enable the services; and how our pervasive fiber plants are being built.

Dr. Hosung Yoon received his Ph.D degree in 2005 from Seoul National University, Korea. Between 2000 and 2001, he worked as a senior researcher at Luxpert Technologies where he was involved in the development of OTDR and radio-over-fiber systems. In 2005, he joined KT Network R&D; and since then, he has worked on a number of projects on KT's optical access network, including WDM-PON, EPON, and EPON reach extenders. Also, he is participating in related standard bodies like FSAN and IEEE P1904.1 working group, as a representative of KT.

FTTx and Burst-mode Electronics: Recent Advances and Bottleneck for Enabling Next-gen 10G PON Hardware Deployments
Frank Chang, Vitesse, USA

Next-gen PONs aim to address the increased bandwidth demand by providing 10Gbps connections. Worldwide next-gen 10G PON field trails by carriers have been carried out since last couple years, and the age of its mass deployment is coming on the horizon. There obviously exist challenges and

significant bottleneck to limit its hardware development, one of the areas is burst-mode electronics. This talk will review the challenges posed by stringent requirements in next-generation 10G PONs from physical-layer IC vendor perspective and discuss the recent advances in implementing burst-mode chipsets and electronic equalization with the objective to achieve backward compatibility, wide dynamic range and reach enhancement.

Frank Chang is currently Principal Engineer, Systems at Vitesse Semiconductors Corp principally specializing in optical system engineering and IC product specifications and definition issues for telecom, datacom and PON access markets. Previously he worked as subsystem architect and project manager roles at JDS Uniphase, Cisco/Pirelli, and Mahi Networks for the development of WDM systems, linecards, and fiber optics components. He has coauthored over 85 peer-reviewed journal and conference articles, contributed to two book chapters and represents Vitesse at standard organizations including the OIF/ITU-T, IEEE802.3, FSAN, and Ethernet Alliance. He has been serving as the member of the technical program committee for OFC/NFOEC for many years in a row and for a number of other international conferences. He holds a Ph.D degree in Optoelectronics from the University of Montreal, and is Senior Member of IEEE/LEOS and OSA.

Speakers:

Mike Bennet; *Lawrence Berkeley Natl. Lab, USA*

Victor Blake; *MSO Consultant, USA*

Fabrice Bourgart; *France Telecom, France*

Ryo Inohara; *KDDI Labs, Japan*

Lowell Lamb, *Broadcom, USA*

David Li; *Ligents Photonics, USA*

Paolo de Lutiis; *Telecom Italia, Italy*

Derek Nesset; *British Telecom, UK*

Vincent A. O'Byrne, *Verizon, USA*

Duane Remein, *FiberHome, USA*

Ken-Ichi Suzuki; *NTT, Japan*

Hosung Yoon; *Korea Telecom, Republic of Korea*

Frank Chang, *Vitesse, USA*

Advances in PON Systems and Deployment Technologies for PON Systems

Category 3. FTTx Technologies, Deployment, and Applications

NWB

Wednesday, March 9, 2011
8:00 AM - 10:00 AM

Event type: Panel

Room number: 515B

Organizer: Junichi Kani; *NTT Access Service Systems Labs, Japan*

Description:

PON systems have been widely spread with help of many technologies such as those for realizing easy and rapid installation as well as providing various advanced services. This panel will try to identify the direction of research and development on PON-related technologies in the next decade by reviewing and discussing various topics such as:

- Recent advances in PON system under deployment,
- Recent advances in technologies to accelerate the deployment of PON systems,
- Issues to further accelerate the worldwide deployment of PON systems,
- Possible deployment of next-generation PON system and its requirements.

Speakers:

FTTH/PON Deployment in Verizon, Christina Colasanto, *Verizon, USA.*

Reducing Installation and Operation Costs of FTTH and PON - Case studies of deployment in Japan , Yoshiaki Miyajima, *Sumitomo Electric Industries, Japan*

Progressive Deployment and Evolution of PON Systems Worldwide, Ronald Heron, *Alcatel Lucent, Canada*

FTTH Roll-out Based on GPON: A Long-term View on Optical Access Evolution in Germany, Nikolaus Gieschen, Armin Ehrhardt, *Deutsche Telekom, Germany*

A Test System for Fiber Identification and Labeling: How a New Technological Solution Can Solve an Old Fiber Access Problem, Pat Iannone, *AT&T, USA.*

Drivers and Applications for High-Speed PON Systems

Category 3. FTTx Technologies, Deployment, and Applications

NMF

Monday, March 7, 2011
4:00 PM - 6:00 PM

Event type: Panel

Room number: 515B

Organizer: Christoph Pfistner; *NeoPhotonics, USA*

Description:

Both GPON and GEPON have become mainstream access network architectures providing connectivity at data rates of up to 2.5 Gbps. In the meantime IEEE and ITU/FSAN are defining the standards for next-generation access networks supporting bandwidth of 10G, and discussions have started on how to push access network speeds even further. This panel will focus on the drivers and applications of high speed PON systems. How do residential video services compare with high bandwidth applications for businesses, and what role will high speed PON systems play in next-generation mobile backhaul?

Join us in this exciting session where executives from service and system providers will present their views on the key drivers of the high-speed PON market. The individual presentations will be followed by a panel discussion and open Q&A session.

Speakers:

Generations of PON: The Right Technology at the Right Time, Frank Effenberger, *Huawei, USA*

DOCSIS Provisioning of EPON (DPoE): Serving Explosive Bandwidth Growth in MSO Networks, Marek Hajduczenia

Power Consumption and Subscriber Density: Considerations for different Next-Gen PON Architectures, Lowell Lamb, *Broadcom, USA*

Drivers, Applications and Key Technologies for Next-Generation High-Capacity PON Systems, Shunji Kimura, *NTT, Japan*

Evolution and Trends in Video are Driving an Increase in overall Network Bandwidth, Michael Ruffini, *Verizon, USA*

Hyper Connectivity and the Approaching Zeta Byte Era, Chris Stiles, *Cisco, USA*

FTTH Around the World: Today and Tomorrow

Category 3. FTTx Technologies, Deployment, and Applications

NWF

Wednesday, March 9, 2011
3:30 PM - 5:30 PM

Event type: Panel

Room number: 515B

Organizer: Shoichi Hanatani; *Hitachi, Japan*

Description:

FTTx (H) global broadband market is going to keep a healthy growth with more than 50 million subscribers achieved in 2010, even while we have been still suffering from a world economic recession today. This panel reviews the present FTTH deployment status region by region with an analysis to extract key driving factors, and discusses governmental regulatory/policy issues as well as technology trends to help the FTTH market more successfully solve any hindering factors in the emerging market region. The panel is supported by FTTH Council North America, Europe and Asia-Pacific.

Speakers:

Shigeki Suzuki, *National Institute of Information and Communication Technlogy (NICT), Japan*

Daniel O'connell, *Fiber to the Home Council North America, USA*

Martin Hatas, *Fiber to the Home Council Europe, Sweden*

Bernard Lee, *Telekom Malaysia, Malaysia*

Next-Generation Fibers for High Capacity Transmission—Radical Solutions

Category 5. Fibers and Optical Propagation Effects

OSuA

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Event type: Workshop

Room number: 403A

Organizer:

Hans Limberger[1], David Richardson[2], Toshio Morioka[3]; *[1]Ecole Polytechnique Federale de Lausanne, Switzerland; [2]Optoelectronics Res. Ctr., Univ. of Southampton, UK; [3]NTT Network Innovation Laboratories, Japan*

Description:

Driven by the exponentially growing demand for capacity, it is already apparent that the next generation of telecommunication networks will be radically different from previous implementations; coherent detection along with powerful digital signal processing will be deployed to maximize the available capacity of each fiber strand within the network. However, applied in isolation these techniques will only delay the inevitable "capacity crunch" by a few years and without radical innovation in the basic internet infrastructure future internet growth will be severely constrained. Research on new transmission fibers and amplifiers is therefore now urgently required. In this workshop we will review and discuss some of the potential technological options and consider their potential and viability of these from a capacity, power handling and energy sustainability perspective.

Speakers:

Introduction: Capacity Crunch and Why We Need Radical New Solutions to Get More Capacity
Toshio Morioka, *NTT Network Innovation Labs, Japan*

Fundamental Limits of Transport over Fibers: Commercial and Advanced Fibers
Rene Essiambre, *Alcatel Lucent, USA*

How to Increase the Capacity Without an Energy Crunch?
Shu Namiki, *National Inst. of Advanced Industrial Science and Technology, Japan*

Air Core Photonic Bandgap Fibers for High Capacity Data Transmission: Challenges, Potential and State-Of-The-Art
Francesco Poletti, *ORC, Univ. of Southampton, UK*

Recent Progress in Multi-Core Fibers: Their Prospects and Potentials
Masanori Koshiba, *Hokkaido Univ., Japan*

Mode Group Diversity Multiplexing in Oligomode/Multimode Fiber Links
Ton (A.M.J.) Koonen, *Eindhoven Univ. of Technology, The Netherlands*

Multicore Fiber Transmission and Connectivity
Benyuan Zhu, *OFS*

Bi-Doped Fiber Amplifiers for a Spectral Region of 1300-1500nm: Opportunities and Challenges
Evgueni M. Dianov, *Fiber Optics Res. Ctr. RAS, Russia*

Reliability Issues in Next Generation Fibers: Fiber Fuse Problem
Kenji Kurokawa, *NTT Access Network Service Systems Labs., Japan*

The System Operator Perspective of the Capacity Crunch/New Fiber Deployments
Daniel Peterson, *Verizon, USA*

Discussion
Led by: David Richardson, *ORC, Univ. of Southampton, UK*

Best Saturable Absorber for Mode-Locked Fiber Lasers: SESAM, CNT, or Graphene?

Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors

OSuB

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Event type: Workshop

Room number: 404 A&B

Organizer: Sze Y. Set[1], Ju Han Lee[2], Morten Ibsen[3]; *[1]Alnair Labs Corp., Japan, [2]Univ. of Seoul, Republic of Korea,[3]Univ. of Southampton, UK*

Description: Recently a number of new exciting saturable absorbers have emerged for passive mode-locking of fiber lasers to challenge the more established semiconductor-type mode-locker. Some of these new materials, including Carbon Nanotubes (CNTs) and Graphene, boast a much wider bandwidth of operation, much quicker recovery time, and evidently are also more efficient at providing shorter pulses and higher pulse energies than traditionally used materials. Is this likely for these nano-carbon materials to replace the SESAM as the material of choice for passive mode-locking of fiber lasers? There are still issues to be resolved related to CNTs and Graphene though, including not least their long-term stability and reliability. This workshop will debate the pros and cons of these various mode-locking technologies and will attempt to establish whether the time has come for SESAM to give way to the emerging nano-carbon-based technologies as the best saturable absorber for passive mode-locking of fiber lasers.

Speakers:

Sze Yun Set, *Alnair Labs Corp., Japan*

Leslie Kolodziejski, *MIT, USA*

Vladimir Stasyuk, *PriTel Inc., USA*

Thomas Südmeyer, *ETH Zürich, Switzerland*

Yong Won Song, *KIST, Republic of Korea*

Luming Zhao, *Nanyang Technological Univ., Singapore*

Tawfique Hasan, *Univ. of Cambridge, UK*

Shinji Yamashita, *University of Tokyo, Japan*

Jeff Nicholson, *OFS Laboratories, USA*

Is Si Photonics Applicable to the Telecom Industry?

Category 7. Optical Devices for Switching, Filtering, and Signal Compensation

OMB

Monday, March 7, 2011
8:00 AM - 11:00 AM

Event type: Workshop

Room number: 408B

Organizer: Solomon Assefa[1], Christopher R. Doerr[2]; *[1]IBM T. J. Watson Research Ctr, USA, [2]Bell Laboratories, Alcatel-Lucent, USA*

Description: Research and development in silicon photonics have advanced dramatically during the last decade. Successful demonstrations have shown that silicon-based photonic devices are capable of low-power and high-bandwidth operation while occupying a small footprint. Additionally, CMOS-photonics integration technology has gained enough maturity that commercial products are already on the horizon. Until now, these activities have been heavily focused on optical interconnect applications for high performance computing systems and consumer electronics. However, could the advances made in silicon photonics find a use in the telecom industry, which has much longer links and higher data rates? Are the device performance, power consumption, and cost metrics conceived for optical interconnects reasonable for telecom applications? Is there a market need and incentive for silicon photonics in the telecom industry? If so, what portions of the telecom industry? The workshop will explore these questions, and many others, in an effort to construct an outlook for the application of silicon photonics in the telecom industry.

Speakers:

John Bowers, *UCSB, USA*

Andy Carter, *OClaro, USA*

Mehdi Asghari, *Kotura, USA*

Michal Lipson, *Cornell Univ., USA*

Kal Shastri, *Lightwire, USA*

Koji Yamada, *NTT, Japan*

Christopher Doerr, *Bell Labs, Alcatel-Lucent, USA*

Tom Koch, *Lehigh University, USA*

Ed Murphy, *JDSU, USA*

Bikash Koley, *Google, USA*

Michael Frankel, *Ciena, USA*

Photonic Integration: More Technologies than Applications?

Category 8. Optoelectronic Devices

OSuC

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Event type: Workshop

Room number: 408B

Organizer: Martin Schell[1], Andreas Beling[2]; *[1]Fraunhofer Inst. for Telecommunications, Heinrich Hertz Inst., Germany, [2]u2t Photonics AG, Germany*

Description: The last five years have seen a tremendous growth of R&D activities in Photonic Integration. A multitude of material systems and integration platforms like Silicon, Silicon-On-Insulator, Glass, InP monolithic with and without overgrowth processes, LiNbO3, or polymers has been investigated. The commercial success, however, has so far been restricted to a limited subset of these technologies. Is this only a consequence of different levels of maturity? Or will there be a consolidation to a one-size-fits-all technology, allowing for largest concentration and consolidation of efforts? This workshop will discuss and compare the potential chances and application fields of these integration technologies and try to give an outlook, what technology may be the most suitable for which application.

Speakers:

Mehdi Ashgari, *Kotura, USA*

Roel Baets, *Univ. Gent, Belgium*

John Bowers, *Univ. of Calif., Santa Barbara, USA*

Steve Clements, *u2t, Germany*

Takehito Tanaka, *Fujitsu Optical Components, Japan*

Norbert Keil, *HHI, Germany*

David Welch, *Infinera, USA*

Meint Smit, *Univ. Eindhoven, The Netherlands*

Senichi Suzuki, *NTT Photonics Lab, Japan*

Valery Tolstikhin, *OneChip Photonics, Canada*

Flexible Optical Networking Capacity at Its Limits?

Category 9. Digital Transmission Systems

OMD

Monday, March 7, 2011
8:00 AM - 11:00 AM

Event type: Workshop

Room number: 502B

Organizer: Yi Cai[1], Peter Winzer[2]; *[1]Tyco Electronics Subsea Communications LLC, USA, [2]Bell Labs, Alcatel-Lucent, USA*

Description: Over the past decade, optical fiber communications has embraced coherent detection with multi-level modulation and polarization-division multiplexing using sophisticated digital signal processing and forward error correction as a way to increase both WDM capacities and transponder flexibility. However, recent studies suggest that the capacity in single-mode optical fiber is reaching its fundamental limits, and that energy considerations may stand against the use of heavy digital signal processing needed for ultimate transponder flexibility. In this workshop, we address fundamental and practical/economic limits to optical transport capacity and transponder flexibility. This includes an assessment of Shannon limits and ways to approach them in a classical and in a quantum context, spatial multiplexing to increase per-cable transport capacities, and considerations on transponder complexity and energy consumption with a view on flexibility and integration.

Software Defined Optical Transceivers – What Can We Do with Them?

Category 10. Transmission Subsystems and Network Elements

OSuE

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Event type: Workshop

Room number: 502B

Organizer: David Plant[1], Xiang Liu[2], Michael Taylor[3]; *[1]McGill Univ., Canada, [2]Bell Labs, Alcatel-Lucent, USA, [3]Atlantic Sciences/Optametra, USA*

Description: The workshop will debate the need for smart, data-rate and format agile, impairment aware/tolerant software-defined transceivers for future optical transmission systems. Potential application of such transceivers in traditional fiber communications systems as well as emerging data center centric networks will be discussed. Implementation aspects of these transceivers will also be discussed.

Speakers:

Donn Lee, *Facebook, USA*

Mark Feuer, *AT&T, USA*

Steve Gringeri, *Verizon, USA*

Hidehiko Takara, *NTT, Japan*

Kim Roberts, *Ciena, Canada*

Dayou Qian, *NEC, USA*

Idelfonso Tafur Monroy, *CHRON project, Denmark*

Jean-Christophe Antona, *Alcatel-Lucent, France*

Jörg-Peter Elbers, *ADVA, Germany*

Patricia Bower, *Fujitsu Semiconductor, Canada*

Where Can Optical Analog-Digital Conversion Compete?

Category 11. Optical Processing and Analog Subsystems

OSuD

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Event type: Workshop

Room number: 409 A&B

Organizer: Michael Dennis[1], Keith Williams[2]; *[1]Johns Hopkins Univ. Applied Physics Lab, USA, [2]Naval Research Lab, USA*

Description:

Speakers:
Ken-Ichi Kitayama, *Osaka Univ., Japan*
Darko Zibar, *Technical Univ. of Denmark, Denmark*
Stojan Radic, *Univ. of Calif. San Diego, USA*
Ian Dedic, *Fujitsu Semiconductor Europe, UK*
Bahram Jalali, *Univ. of Calif, Los Angeles, USA*
Alexander Gaeta, *Cornell Univ., USA*
Miguel Piqueras, *DAS Photonics S.L., Spain*
Colja Schubert, *Heinrich Hertz Inst., Germany*
Michael Dennis, *Johns Hopkins Univ. Applied Physics Lab., USA*
Keith Williams, *US Naval Research Lab., USA*
Thomas Clark, *Johns Hopkins Univ. Applied Physics Lab., USA*

Spectrally/Bit-Rate Flexible Optical Network Design and Operation

Category 12. Core Networks

OMC

Monday, March 7, 2011
8:00 AM - 11:00 AM

Event type: Workshop

Room number: 502A

Organizer: Andrew Lord[1], Annalisa Morea[2]; *[1]BT, UK, [2]Alcatel-Lucent Bell Labs, France*

Description:

Since the very beginning of WDM, the available optical spectrum has been divided into fixed frequencies according to the standardized ITU-grid. Flexible, dynamic optical networks, ITU-grid based, are now available and installed worldwide. A further step would be to better adapt the transported optical signals to the incoming data, hence allow optical bandwidth and capacity to be completely elastic. Advantages are to improve flexibility and spectrum efficiency. Flexible optical filters and transmission techniques such as OFDM are key enablers. However, the optical component industry has relied on fixed ITU-grid and capacity to help reduce costs of transponder and filters.

This workshop will explore whether elastic networks are cost-effective solutions. Opinions of operators, component, and equipment vendors will enable a broad ranging and controversial debate.

Speakers:

What is Required Beyond a Flex Spectrum Capable WSS for a Flex Spectrum Network?
Brandon Collings, *JDSU, USA*

Adaptive DWDM: Finally the Right Technology for Optimizing the IP Layer
Ori Gerstel, *Cisco, USA*

Steve Gringeri, *Verizon, USA*

Masashiko Jinno, *NTT, Japan*

Cedric Lam, *Google, USA*

Simon Poole, *Finisar, USA*

Olivier Rival, *Alcatel-Lucent, France*

What Is Next for High-Speed PON: Evolution or Revolution?

Category 13. Access Networks

OSuF

Sunday, March 6, 2011
4:30 PM - 7:30 PM

Event type: Workshop

Room number: 515A

Organizer: Neda Cvijetic[1], Naoto Yoshimoto[2]; *[1]NEC Labs America, USA, [2]NTT AS Labs, Japan*

Description: The workshop will seek to spark a lively debate on the future of high-speed (beyond 10G) PON systems, and the "evolutionary" versus "revolutionary" forces at play in this space. Will the next generation of optical access boldly march towards novel architectures, features and technologies, or adopt a less "disruptive" path and more closely resemble its predecessors? Moreover, will this course be set by cost? Technology? Both? Neither? Join us for an exciting, highly-interactive discussion which will address the topic from the technical, economic, and regulatory perspectives. Audience participation and strong opinions welcome.

Speakers: Hiyasa Hadama, *NTT, Japan*
Shweta Jain, *Verizon, USA*
Ching-Sheu Wang, *Chunghwa Telecom, Taiwan*
Klaus Grobe, *ADVA, Germany*
Bas Huiszoon, *Genexis, Spain*
Josep Prat, *Universitat Politècnica de Catalunya, Spain*
Tuomo von Lerber, *Technische Universität Darmstadt / Luxdyne Ltd, Germany*
Dave Piehler, *Neophotonics, USA*
Sylvia Smolorz, *Nokia Siemens Networks, Germany*
Markus Weber, *Fujitsu Semiconductor Europe, Germany*
Akio Tajima, *NEC, Japan*
Benoit Charbonnier, *France Telecom Orange Labs, France*
Xing-Zhi Qiu, *Ghent University, Belgium*

Wireline and Wireless Access Network Integration/Convergence

Category 13. Access Networks

OME

Monday, March 7, 2011
8:00 AM - 11:00 AM

Event type: Workshop

Room number: 515A

Organizer: Milorad Cvijetic[1], Leonid Kazovsky[2],

Moises R. N. Ribeiro[2,3] ; *[1]NEC Corp. of America, USA, [2]Stanford Univ., USA; [3]Federal Univ. of Espirito Santo, Brazil*

Description: In recent years, there has been growing discussion about seamless integration of wireline and wireless access networks to provide both increased mobility and bandwidth for broadband services. Moreover, fiber penetration to end users has opened new vistas to be explored in the broadband access arena. Several large research projects have also been launched on this topic and are complemented by significant testbed developments. In this workshop, key insights and challenges of wireless/wireline access convergence will be discussed from both technology and deployment/operational perspectives. Prominent speakers from leading international carriers, equipment vendors, and academia will be featured.

Speakers: Leonid Kazovsky, *Stanford Univ., USA*
Paul Henry, *AT&T, USA*
Volker Distelrath, *Nokia Siemens Networks, Germany*
Ioannis Tomkos, *Athens Inst. of Technology, Greece*
Katsumi Iwatsuki, *NTT , Japan*
Stefan Dahlfort, *Ericsson, USA*
G. K. Chang, *Georgia Tech, USA*
Armin Ehrhardt, *Deutsche Telecom, USA*
Thomas Pfeiffer, *Alcatel-Lucent, Germany*
Idelfonso Monroy, *DTU, Denmark*
Anthony Ng'Oma, *Corning, USA*
Benoit Charbonnier, *Orange, France*

Exascale Computing: Where Optics Meets Electronics

Category 14. Datacom, Computercom, and Short Range and Experimental Optical Networks

OMA

Monday, March 7, 2011
8:00 AM - 11:00 AM

Event type: Workshop

Room number: 408A

Organizer: Norm Jouppi, Moray McLaren; *Hewlett-Packard Labs, USA*

Description: The roadmap for future high performance computer systems is being defined with the goal of deploying Exascale systems before the end of the decade. Optical interconnects will play a significant part in achieving the aggressive power and bandwidth targets for these systems. The open question is whether optical interconnects will lead to radically different system architectures, or simply more efficient implementations of traditional designs. In this workshop the requirements of various Exascale roadmap options will be discussed in the context of emerging photonic technologies, in particular how photonics might enable advances in system architecture. The workshop will bring together a range of speakers from potential end users, systems companies, and technology suppliers to academia.

Speakers: Scott Hemmert, *Sandia National Lab, USA*
Ray Beausoleil, *HP Labs, USA*
Venkatesh Akella, *UC Davis, USA*
Andrew Alduino, *Intel, USA*

Special Symposia

Meeting the Computercom Challenge: Components and Architectures for Computational Systems and Data Centers

View the Abstracts »

Organizers: *Keren Bergman[1], Chuck Joyner[2], Akihiko Kasukawa[3], Petar Pepeljugoski[4], Clint Schow[4], Michael Tan[5], Ioannis Tomkos[6]; [1]Columbia Univ., USA, [2]Infinera, USA, [3]Yokohama R&D Labs Furukawa Electric Co., Japan,[4]IBM T. J. Watson Res. Ctr., USA, [5]Hewlett Packard Labs, USA,[6]Athens Information Technology Ctr., Greece*

At OFC 2011, a special symposium will again be held to address an increasingly large and important part of the global fiber optics market: interconnects for computer systems and data center networks. The first Computercom symposium at OFC 2010 marked a continuing expansion of OFC programming into the fast growing area of optical communications in computer networks. Performance gains in computer systems are increasingly achieved through interconnecting large numbers of parallel processor nodes. Within the next decade, Exaflop machines will be produced that incorporate tens of millions of optical links. Traditional optical

transceiver modules are too costly, bulky, and power hungry to support this scale of deployment. A new class of optimized short-reach, low-power, and low-cost optical interconnects must therefore be developed to enable next-generation large-scale systems and future, highly-interconnected data centers. Computer and data center networks will continue to be a focus area for the 2011 conference with a complete schedule including showfloor activities, technical sessions, and market perspectives. The Computercom Special Symposium will again be a primary showcase for the topic with a dynamic lineup of invited speakers from computer and data center systems companies, content and cloud-computing providers, and leading research groups. Through the invited and contributed talks, the symposium will provide an extensive background and unique perspective, from the top-down through systems requirements and from the bottom-up through novel hardware under development, on the challenging and fast-growing field of high-performance short-reach optical networks.

The symposium focuses on the components and architectures that will enable the deployment of massive optical networks underpinning next-generation Exa-scale computers and highly interconnected data centers. The topics are concentrated on lowering the cost and power of short-reach optical interconnects (<100m) while simultaneously increasing the aggregate bandwidth.

Topics include but are not limited to:

- Power-efficient optical engines (transmitters and receivers)
- Low-power parallel optical transceivers
- Novel packaging for low-cost integrated optics and parallel transceivers
- Optics/micro-optics for low-loss parallel optical coupling
- Integrated waveguides: chip, module, and board
- Waveguide-to-fiber coupling
- Hybrid Integration, dense co-packaging of optics and drive electronics
- WDM/CWDM interconnects for integrated optics and parallel modules
- Si Photonic devices and on-chip networks for module and chip-scale integration
- Si photonic packaging focused on many channels at low cost
- Low-power drive electronics for current and novel optical devices
- Novel devices and approaches for integrated optics
- VCSELS/multimode links
- MEMs structures for low-cost efficient packaging
- Module and board package design: closely integrating optics with logic
- Current and future requirements for computer and data center interconnects
- Network architectures for improved interconnect bandwidth efficiency
- Network management for optimized power efficiency

Read exclusive interviews with Alan Gara IBM Fellow, Blue Gene Chief Architect and OFC/NFOEC Keynote Speaker and Clint Schow, Research Staff Member at IBM and OFC/NFOEC 2011 Computercom Symposium Organizer

Monday, March 7, 2011
1:30 - 3:30 p.m.
Room 502A
OMM, Meeting the Computercom Challenge Symposium I: Photonic Networks on Chip

Invited Speakers:

1:30 – 2:00 p.m.

OMM1, Systems Aspects of Optical Technologies for Use in Datacommunications, Ian White; *Cambridge Univ., UK*
Ian White is a Pro-Vice-Chancellor and heads the Photonic Research Group in the Engineering Department at the University of Cambridge. He heads one of the most active optoelectronic systems research groups in the UK. He has published in excess of 800 journal and conference papers, and 20 patents. His research includes: the first all-optical laser diode flip flop, the first negative chirp electroabsorption modulator and the commercially important offset launch technique for enhanced bandwidth multi-mode fibre transmission–used in the GbE standard. He chaired part of the IEEE 10 GbE LRM standard taskforce. He is a fellow of the RAE, IEE and IEEE, and is a member of the Board of Governors of the Photonics Society and Editor-in-Chief of Electronics Letters.

3:00 – 3:30 p.m.

OMM6, CMOS Integrated Nanophotonics: Enabling Technology for Exascale Computing Systems, Yurii Vlasov; *IBM T. J. Watson Res. Ctr., USA*
Dr. Yurii Vlasov is a Manager of Silicon Integrated Nanophotonics Department at the IBM TJ Watson Research Center. Prior to joining IBM in 2001, Dr.Vlasov has developed semiconductor nanophotonics at the NEC Research Institute in Princeton, and at the Strasbourg IPCMS Institute, France. He also was, for over a decade, a Research Scientist with the Ioffe Institute of Physics and Technology in St. Petersburg, Russia working on semiconductor optics. He received his MS from the University of St.Petersburg (1988) and the PhD from the Ioffe Institute (1994), both in physics. Dr.Vlasov has co-authored over 100 papers, filed a few dozens of US patents, and delivered over 100 invited and plenary talks in the area of nanophotonic structures. He served on numerous organizing committees of conferences on nanophotonics under OSA, IEEE, LEOS, APS, MRS, etc. Dr. Vlasov is a Fellow of the OSA and the APS, and was named a scientist of the year by the Scientific American journal.

Monday, March 7, 2011
4:00 – 6:00 p.m.
Room 502A
OMV, Meeting the Computercom Challenge Symposium II: Emerging Interconnect Technologies

Invited Speakers

4:00 – 4:30 p.m.

OMV1, The Limits of Switch Bandwidth, Scott Kipp, *Brocade, USA*
Scott Kipp represents Brocade in multiple standards organizations and has written several books on storage networking and fiber optics. Scott contributes to multiple standards organizations including ANSI T11, IEEE 802.3, OIF, IEEE 1619, SNIA, OASIS, IETF and Multi Sourcing Agreements. He specializes in high-speed fiber optic technology. Kipp has written three books for the Fibre Channel Industry Association (FCIA), another entitled Broadband Entertainment and co-authored the Handbook on Fiber Optic Data Communications. He has a Bachelors and a Masters degree in Electrical Engineering from Cal Poly in San Luis Obispo, California.

4:30 – 5:00 p.m.

OMV2, The Future of 100GbE Physical Layer Specifications, John D'Ambrosia; *Force10 Networks, USA*
As the Chief Ethernet Evangelist in the CTO Office at Force10 Networks, John D'Ambrosia is the company's voice in the industry voice for the continuing development and deployment of Ethernet. John has been an active participant in the development of Ethernet-related technologies since 1999. Recently, John served as the chair of the IEEE P802.3ba Task Force, which developed 40 Gb/s and 100 Gb/s Ethernet. Prior to that, John served as secretary for the IEEE 802.3ap Backplane Ethernet Task Force, and participated in the development of XAUI for 10 Gigabit Ethernet. John also is a founder of the Ethernet Alliance and has served as a director and secretary. John was the chair of the XAUI Interoperability work group for the 10 Gigabit Ethernet Alliance. John also acted as secretary for the High Speed Backplane Initiative and chair of the Optical Internetworking Forum's Market Awareness & Education committee. For all of his efforts related to Ethernet, John was recognized by Network World in 2006, as part of its "50 Most Powerful People in Networking" list. Periodically, John posts a popular blog on Ethernet trends for EE Times. Prior to joining Force10, John was with Tyco Electronics for 17 years.

5:30 – 6:00 p.m.

OMV5, State of the Short-Reach Optics Market, Lisa Huff, *Discerning Analytics, LLC, USA*
Lisa Huff is Chief Technology Analyst at DataCenterStocks.com and Principal Analyst at Discerning Analytics, LLC. She is a Certified Data Center Professional (CDCP) and degreed electrical engineer with more than 25 years experience in the electronics industry. She has held various industry marketing and engineering positions at Berk-Tek, A Nexans Company, Communications Industry Researchers, FCI and Tyco Electronics. Her expertise is in data centers, data communications cabling and connectivity, networking equipment and optical components. Lisa writes for two blogs: DataCenterStocks and Optical Components. Her recent publications can be found at Discerning Analytics Web site.

Tuesday, March 8, 2011
2:00 – 4:00 p.m.
Room 502A
OTuH, Meeting the Computercom Challenge Symposium III: Optics in Datacenters

Invited Speakers

2:00 – 2:30 p.m.

OTuH1, Optical Systems for Data Centers, Ron Ho; *Oracle/Sun Microsystems Labs, USA*
Ron Ho is a Hardware Architect at Oracle. Formerly, he was a Distinguished Principal Engineer and Director at Sun Microsystems. He received his Ph.D. in electrical engineering from Stanford University. Ron worked at Intel Corporation, Santa Clara, CA, on processor projects ranging from the 486 to the Itanium generations, before joining Sun Labs, Menlo Park, CA, where he has been working on chip-to-chip and on-chip communication technologies. In 2004, Sun awarded him its Chairman's Award for Innovation for his work on Proximity Communication. Dr. Ho has been on the technical program committees for the IEEE ISSCC, A-SSCC, HotInterconnects, Asynchronous Circuits & Systems, and VLSI-DAT conferences and has served as guest editor for the IEEE Journal of Solid-State Circuits and the Journal of Quantum Electronics. He has over 60 publications and over 30 patents. Ron is a Senior Member of the IEEE.

2:30 – 3:00 p.m.

OTuH2, The Emerging Optical Data Center, Amin Vahdat; *Univ. of California at San Diego, USA*
Amin Vahdat is a Member of the Technical Staff at Google working on data center networking. He is on leave from a faculty position at UC San Diego, where he holds the Science Applications International Corporation Chair in the Department of Computer Science and Engineering at the University of California San Diego. Vahdat's research focuses on the scale, performance, and reliability of computer networks, distributed systems, virtualization environments, and operating systems. He received his PhD in Computer Science from UC Berkeley, was a researcher at the University of Washington, and on the faculty at Duke University.

3:30 – 4:00 p.m.

OTuH2, Fiber and Copper Cabling in Data Centers, Doug Coleman; *Corning, USA*
Since joining Corning Cable Systems in 1979, Doug Coleman has held positions in process engineering, product engineering and applications engineering. He currently serves as a marketing manager responsible for technology and standards in the private networks market. Mr. Coleman was

recently named a Distinguished Associate, an honor which recognizes continuous exemplary performance and significant contributions to Corning Incorporated. Mr. Coleman has been awarded nine domestic patents and 12 international patents, has published numerous articles, and made presentations at technical forums such as BICSI, ACUTA, 7x24, AFCOM and SCTE. He is a graduate of the University of North Carolina at Chapel Hill.

Tuesday, March 8, 2011
4:30 – 6:30 p.m.
Room 502A
OTuQ, Meeting the Computercom Challenge Symposium IV: Component Technology

Invited Speakers:

4:30 – 5:00 p.m.

OTuQ1, Taking the Cost Out of Short-Reach Optical Interconnects, Kenneth Jackson, *Emcore Corp., USA*
Dr. Kenneth Jackson has spent over 25 years in the fiber-optic communications field. He has held various research and development positions at IBM, JDSU and Emcore involved in the development of serial and parallel modules for enterprise interconnect applications. In the mid- 1990s, Dr. Jackson was a key member of IBM's Rochester, Minnesota team that was largely responsible for the resurgence of 850nm laser-based transceivers for low-cost data links. Dr. Jackson has authored many journal articles and made numerous technical presentations at fiberoptic conferences. He holds five patents. Dr. Jackson is currently the product line manager for Emcore Corporation's parallel optical devices.

6:00 – 6:30 p.m.

OTuQ6, Engineering a 150 Gbit/s Optical Active Cable to Meet the Needs of the Data Center Environment, Takehiko Tokoro, *Hitachi Cable, USA*
Takehiko Tokoro received a B.E. from the College of Engineering Sciences, University of Tsukuba (major: Applied Physics) in 1984, and a M.E. degree from the Graduate School of Science and Engineering, University of Tsukuba (major: Materials Science) in 1986, Tsukuba, Japan. In 1986, he joined Hitachi Cable, Ltd., Hitachi, Japan, where he has been engaged in R&D of high-speed fiber-optic transmitter/receiver ICs, transceiver modules and optical interconnection technologies as the research engineer. Since 2007, he has been the general manager of the Optical & Electronic Integration Technology Dept. in Hitachi Cable's R&D Lab.

Wednesday, March 9, 2011
8:00 – 10:00 a.m.

Room 502A
OWH, Meeting the Computercom Challenge Symposium V: Optical Interconnect for High-Performance Computing

Invited Speakers:

8:00 – 8:30 a.m.

OWH1, Tsubame–2 - a 2.4 PFLOPS Peak Performance System, Takao Hatazaki; *Hewlett-Packard, Japan*
Takao Hatazaki started his career as a computer systems engineer in 1987, then involved in compiler development and MPI library development. He has been acting as an HPC technology consultant since he joined Compaq in 1999 through its later acquisition by Hewlett-Packard. He published several translation books, including an MPI programming and numerical methods, as well as several technical papers, including MPI optimization and parallel computing optimizations, in international conferences. He acted as a technical lead throughout Tsubame-2.0 proposal and delivery. He holds BS in electric engineering and MS in computer science.

8:30 – 9:00 a.m.

OWH2, Photonics for HPEC: A Low-Powered Solution for High Bandwidth Applications, *Robert Bond*
Robert Bond is the leader of the MIT Lincoln Laboratory Embedded and High Performance Computing Group. The group works on a wide range of technologies spanning custom VLSI circuits, parallel processors, non-linear signal processing, graph detection theory, and parallel processing middleware. In his career, Mr. Bond has focused on the research and development of high-performance embedded signal and image processors and algorithms. Prior to coming to Lincoln Laboratory, he worked at CAE Ltd. on radar, navigation, and Kalman filter applications for flight simulators, and then at Sperry where he developed Naval command and control applications. He joined Lincoln Laboratory in 1987. In his first assignment, he was responsible for the development of the Mountaintop RSTER radar software architecture and later led the radar system integration. In the early 1990s, he led seminal studies to evaluate the use of massively parallel processors (MPP) for real-time signal and image processing. Later, he led the development of 1000-processor MPP for radar space-time adaptive processing and a custom VLSI processor for high-throughput radar signal processing. In 2001, he led a team in the development of the Parallel Vector Library, a novel middleware technology for portable and scalable high-performance parallel signal processors. In 2003 he was one of two researchers to receive the Lincoln Laboratory Technical Excellence Award for his "technical vision and leadership in the application of high-performance embedded processing architectures to real-time digital signal processing systems." He earned a B.S. degree (honors) in physics from Queen's University, Ontario, Canada in 1978.

9:30 – 10:00 a.m.

OWH5, Optical Interconnects in Future HPC Systems, Steven Scott; *Cray, USA*
Steve Scott is Senior Vice President and Chief Technology Officer at Cray Inc., where he has been since receiving his PhD in computer architecture from the University of Wisconsin at Madison in 1992. Steve was the Chief Architect of multiple systems at Cray, architected the routers for the Cray XT line and follow-on systems, and is leading the Cray Cascade project funded by the DARPA High Productivity Computing Systems program. Steve holds twenty-three US patents, and has served on numerous program committees. He was the 2005 recipient of the ACM Maurice Wilkes Award and the IEEE
Seymour Cray Computer Engineering Award.

Packet Switching Symposium

Mounir Hamdi[1], Andreas Kirstädter[2], Dominic Schupke[3]; [1]Hong Kong Univ. of Science and Technology, Hong Kong,[2]Univ. of Stuttgart, Germany, [3]Nokia Siemens Networks, Germany

The Packet Switching Symposium serves as a forum to explore and highlight significant opportunities and challenges facing the future of packet switching in all its applications (e.g., routing and network design, data centers, optical networking, etc.). Key leaders from academia and industry will give invited presentations and exchange ideas that may stimulate and guide industry and academic research efforts over the next 5-10 years. In addition to the invited presentations, there will be a panel discussion comprised of experts representing a broad range of viewpoints and technology.

The presentations will span a wide range of topics:

- Packet optical transport networks
- Innovative switch and router architectures
- High-performance packet scheduling hardware and algorithms
- Optical switching and routing
- Data center designs and management
- Power-aware switching and routing
- Security-aware routers, switches, data centers, and storage systems
- High-performance storage area networks
- Quality of services support in switches/routers
- Network monitoring, management, and operations

Tuesday, March 8, 2011
2:00 – 4:00 p.m.
Room 409 A & B
OTuG, Packet Switching Symposium I

Invited Speakers:

2:00 – 2:30 p.m.

OTuG1, Transport Networks at a Crossroads: The Roles of MPLS and OTN in Multilayer Networks, Kireeti Kompella; *Juniper Networks, USA*
Kireeti Kompella is CTO and Chief Architect, Junos at Juniper Networks. His responsibiities include nurturing Junos on all Juniper platforms while exploring new horizons for Junos. His other interests include Packet Transport and large-scale MPLS. Dr. Kompella is active at the IETF where he was a co-chair of the CCAMP Working Group and the author of several Internet Drafts and RFCs in the areas of CCAMP, IS-IS, L2VPN, MPLS, OSPF and TE. He specializes in Layer 2 VPNs, Metro Ethernet, Virtual Private LAN Service, and the use of MPLS in access networks and mobile backhaul. Previously, he worked in the area of filesystems at Network Appliance and SGI; and earlier still in security and cryptography. Dr. Kompella received his B.S. in Electrical Engineering and M.S. in Computer Science at the Indian Institute of Technology, Kanpur; and his PhD in Computer Science at the University of Southern California.

2:30 – 3:00 p.m.

OTuG2, Bufferless Optical Clos Switches for Data Centers, H. Jonathan Chao; *Polytechnic Inst. of New York Univ., USA*
H. Jonathan Chao is Department Head and Professor of Electrical and Computer Engineering at Polytechnic Institute of New York University, Brooklyn, NY, where he joined in January 1992. He has been doing research in the areas of terabit switches/routers, network security, network on the chip, and quality of service control in high-speed networks. He holds 33 patents and has published 3 networking/switching books and over 180 journal and conference papers. During 2000–2001, he was Co-Founder and CTO of Coree Networks, NJ. From 1985 to 1992, he was a Member of Technical Staff at Telcordia. He is an IEEE Fellow.

3:00 – 3:30 p.m.

OTuG3, Optical Networking for Cloud Computing, Thomas M. Bohnert; *SAP Res. CEC Zurich, SAP AG, Switzerland*
Thomas Michael Bohnert (http://tmb.nginet.de) is a senior research scientist at SAP Research. His interests are focused on enabling ICT infrastructures for enterprises. At SAP this covers cloud computing, service oriented infrastructure, and carrier-grade service delivery platforms (Telco + IT). Before joining SAP he worked for John Deere & Company, Siemens Corporate Technology, and ran an IT consultancy named BNCS. He was a visiting scholar with Tampere University of Technology, NEC Network Research Labs, VTT Technical Research Centre, and Beijing University of Posts and Telecommunications. His works have been published in several books, journals and conferences. He regularly serves as reviewer for the IEEE Communications Magazine and serves as regional correspondent (Europe) for the magazine's news section. He is the founder of the IEEE Broadband Wireless Access Workshop (www.bwaws.org) and is a steering board member of the European technology platform eMobility.

3:30 – 4:00 p.m.

OTuG4, Optical Packet Switching Meets Mythbusters, Rod Tucker; *Inst. for a Broadband-Enabled Society (IBES) and Ctr. for Ultra-Broadband Information Networks (CUBIN), Dept. of Electrical and Electronic Engineering, Univ. of Melbourne, Australia*
Rod Tucker is a Laureate Professor at the University of Melbourne and Director of the University of Melbourne's Institute for a Broadband-Enabled Society (IBES). He is also Director of the Centre for Energy-Efficient Telecommunications (CEET). Professor Tucker leads a group of researchers working on broadband access technologies, energy efficiency in telecommunications, and the application of broadband technologies as key social infrastructure. He is a Fellow of the Australian Academy of Science, the Australian Academy of Technological Sciences and Engineering and the IEEE. He was awarded the Australia Prize in 1997 and the IEEE Photonics Society Aron Kressel Award in 2007.

Tuesday, March 8, 2011
4:30 – 6:30 p.m.
Room 409 A & B
OTuP, Packet Switching Symposium II

Invited speakers:

4:30 – 5:00 p.m.

OTuP1, Integrated Electrical/Optical Switching for Future Energy Efficient Packet Networks, Gert Eilenberger; *Alcatel-Lucent Deutschland AG, Germany*
Gert J. Eilenberger is a department head at Alcatel-Lucent Bell Labs in Stuttgart, Germany, with primary research focus on future high speed packet transport networks and their control. His work experience includes STM and ATM switching; concepts and architectures for optical core and metro networks based on WDM and burst/packet techniques; optical switching systems; OAM and control/management concepts; and various system experiments in many German national and European research projects. He studied communication engineering and received Dipl.-Ing. and Dr.-Ing. degrees both from the University of Stuttgart. Dr Eilenberger has authored more than 55 technical papers and holds 10 patents.

5:00 – 5:30 p.m.

OTuP2, Hybrid Circuit/Packet Technologies for the Future Optical Internet, Biswanath Mukherjee; *Univ. of California at Davis, USA*
Biswanath Mukherjee is Child Family Chair Professor at University of California, Davis, where he was Chairman of Computer Science from 1997 to 2000. He received BTech from IIT-Kharagpur (1980) and PhD from University of Washington, Seattle (1987). He was TPC Co-Chair of OFC-2009 and TPC Chair of IEEE INFOCOM-96. He is General Co-Chair of OFC-2011. He is Editor of Springer's Optical Networks Book Series. He has served on eight

journal editorial boards, most notably IEEE/ACM Transactions on Networking and IEEE Network. He has supervised 43 PhDs to completion and currently has 20 advisees, mainly PhD students. He is co-winner of Optical Networking Symposium Best Paper Awards at IEEE Globecom 2007 and 2008. He is author of "Optical WDM Networks" (Springer, January 2006). He served a 5-year term on the Board of Directors of IPLocks, a Silicon Valley company. He has served on the Technical Advisory Board of several startup companies. He is an IEEE Fellow.

5:30 – 6:00 p.m.

OTuP3, Efficient Optical Packet Transport in Access, Metro, and Core Networks, Achim Autenrieth; *ADVA Optical Networking, Germany*
Achim Autenrieth received his Dipl.-Ing. and Dr.-Ing. degree in Electrical Engineering and Information Technology from the Munich University of Technology (TUM), Germany, in 1996 and 2003, respectively. From January 2003 to March 2007 he was with Siemens AG and Siemens Networks GmbH & Co KG. From April 2007 to May 2010 he was with Nokia Siemens Networks, where he was last working as Head of BCS R&D Innovations. Since June 2010 he is with ADVA AG Optical Networking Advance Technology department in the CTO Office. His research interests are in the design and evaluation of multilayer transport networks and control plane. Achim Autenrieth is a member of IEEE and VDE/ITG.

6:00 – 6:30 p.m.

OTuP4, Terabit Optical Ethernet and Enabling Integration Technologies, Daniel J. Blumenthal, *Terabit Optical Ethernet Center (TOEC) and University of California at Santa Barbara, USA*
Daniel J. Blumenthal is Professor in the Department of Electrical and Computer Engineering at the University of California, Santa Barbara. Dr. Blumenthal is Director of the Terabit Optical Ethernet Cetner (TOEC). He serves on the Board of Directors for National LambdaRail and the Internet2 Architecture Advisory Council. He is a co-founder of Calient Networks and Packet Photonics, Inc. Dr. Blumenthal's research interests are in optical communications, photonic packet switching and all-optical networks, all-optical wavelength conversion and regeneration, ultra-fast communications, InP Photonic Integrated Circuits (PICS) and nanophotonic device technologies. He has authored or co-authored over 350 papers, holds 7 patents and is co-author of Tunable Laser Diodes and Related Optical Sources (IEEE–Wiley, 2005). Dr. Blumenthal is a Fellow of the IEEE and Fellow of the OSA. He is recipient of a Presidential Early Career Award for Scientists and Engineers from the White House, a National Science Foundation Young Investigator Award, and a Office of Naval Research Young Investigator Program Award.

Wednesday, March 9, 2011
1:00 – 3:00 p.m. Room 409 A & B
OWP, Packet Switching Symposium III

Invited speakers:

1:00 – 1:30 p.m.

OWP1, Realistic Approaches to Scaling the IP Network Using Optics, Ori Gerstel; *Cisco, Israel*
Ori Gerstel is a Principal Engineer at Cisco, where he leads the architecture work on integration of IP and transport core technologies. Before joining Cisco in 2002, Ori held senior architecture and research positions at Nortel, Tellabs, and IBM where he developed the first generation of photonic crossconnects and mesh DWDM systems. For his contribution, he was awarded the grade of IEEE Fellow. Ori authored over 60 papers in international conferences and journals and over 20 patents on optical networks. He served as conference committee member and co-chair of several communication conferences such as OFC. He also serves as an editor for international journals such as JOCN and has been teaching short courses at OFC. Ori holds a Ph.D. degree from the Technion.

1:30 – 2:00 p.m.

OWP2, MPLS with a Simple OPEN Control Plane, Guru Parulkar; *Stanford Univ., USA*
Guru Parulkar (www.parulkar.com) is the Executive Director of Clean Slate Program and Consulting Professor of EE at Stanford since August 2007. He has been in the field of networking for over 25 years and cherishes opportunities he has had to work with great people. Guru has worked in academia (Washington University in St. Louis and now Stanford), startups (Growth Networks and others), a large company (Cisco), a top tier venture capital firm (NEA), and a federal funding agency (NSF). Before Stanford, Guru spent four years at National Science Foundation (NSF) and worked with the broader research community and NSF CISE team to champion and create programs such as GENI, Future Internet Design, and Network of Sensor Systems. He received NSF Director's award for Program Management excellence. Before NSF, Guru spent four years in Silicon Valley doing successful and not so successful startups such as Growth Networks, Tenaya Networks, Sceos (Ruckus Wireless), and Nevis Networks. He received NEA's Entrepreneurship Award in 2001 for Growth Networks. Before startups, Guru spent over 12 years at Washington University in St. Louis where he was a Professor of Computer Science and Director of Applied Research Laboratory and led research and prototyping of high performance networking and multimedia systems such as the virtual memory system of NetBSD and FreeBSD Unix, APIC gigabit network interface, router plug-in software, packet striping algorithms, multimedia on demand server and service, and real Time upcall system for QoS for NetBSD and others. Guru received PhD in Computer Science from the University of Delaware in 1987 (advisor: Dave Farber). He is a recipient of Alumni Outstanding Achievement award and Frank A. Pehrson Graduate Student Achievement award from the University of Delaware.

2:00 – 2:30 p.m.

OWP3, Optimized IP-MPLS Transport for Optical Networks with Next Gen Switching, Pathmal Gunawardana; *Nokia Siemens Networks, USA*
Pathmal Gunawardana is responsible for the optical business unit in North

America. In this role he leads a team focused in regional product management, technical sales, business development and sales functions for the optical products for Nokia Siemens Networks North America Division. Prior to joining Nokia Siemens Networks Pathmal Gunawardana held senior management positions in business development at Alcatel-Lucent optical division in North America and in global product management for optical/digital cross-connects at Lucent Technologies in USA and in Germany. Pathmal obtained a BS (Honors) in Computer Science and a Masters in International Management from University of Denver, Colorado. He has also completed executive education course at Columbia Business School in New York.

2:30 – 3:00 p.m.

OWP4, Scalable Control Plane Architecture for Optical Flow Switched Networks, Vincent Chan; *MIT, USA*
Vincent W. S. Chan, the Joan and Irwin Jacobs Professor and member of the Claude E. Shannon Communication and Network Group at MIT, received his BS(71)/MS(71)/EE(72)/PhD(74) degrees from MIT. He was Head of the Communications Division of Lincoln Laboratory and the Director of the Laboratory for Information and Decision Systems of MIT. He initiated the Laser Inter-satellite Transmission Experiment and the GeoLITE Programs and formed the MIT/AT&T/DEC All-Optical-Network Consortium and the AT&T/Cabletron/MIT/Nortel/JDS Next Generation Internet Consortium. He is the Editor-in-Chief of the Journal of Optical Communications and Networking, and a Fellow of the IEEE and the Optical Society of America.

Wednesday, March 9, 2011
3:30 – 5:30 p.m.
Room 409 A & B
OWY, Packet Switching Symposium IV: Panel Discussion